JPRS-CST-92-009
12 MAY 1992

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JPRS Report

Science & Technology

China
S&T POLICY

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Zhu Lilan on Trends of S&T Development, China's Strategy

92FE0155E Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 29 Oct 91 p 2

[Revised text of speech by Zhu Lilan [2612 7787 5695], vice minister of the State Science and Technology Commission, at the Hebei Province High and New Technology Conference: "New S&T Development Trends and China's Countermeasures"]

[Text] Abstract: Although national conditions are different in each country of the world, one common characteristic is that they are increasing investments in S&T, increasing comprehensive national strengths, and strengthening their competitiveness. Our strategy is to focus on the "three levels" and "six plans", and continue to promote reform of the S&T system.

There have been qualitative changes in the breadth, depth, and speed of the development of science and technology. The content of S&T itself has been deepened, the fields of S&T have broadened, and there have been changes in the status and role of S&T in overall social development.

I. Trends

Starting first with the speed of development, it is no longer a regular speed. There have been more new discoveries and new inventions since the 1960's than during the past 2,000-plus years. At the same time, the pace of renewal of new technologies and new products has accelerated. Some 30 percent of the industrial technologies that were developed during the past 20 years have already become outdated now, and in particular 50 percent of those in the electronics realm have become outdated. Computers are now in their fifth generation from 1945 to today and computing speeds have increased 10-fold every 6 years while memory capacity has increased 60-fold every 6 years. The fastest operating speed of the "super-supercomputers" in the United States has now reached 32 billion/second. The cycle for the conversion of S&T achievements into commodities has also speeded up. In the 18th Century, it took about 100 years for S&T to be converted into a technology and then into a commodity. This period was 50 years during the 19th Century, 30 years prior to World War I, 7 years after World War II, and 3 to 5 years now and it may take just 2 or 3 years for conversion into a commodity.

Second, the effects of new breakthroughs in scientific research on overall social forces of production are more apparent. Examples include high- temperature superconductivity research, nuclear fusion research, life sciences research, subminiature scale S&T research, and so on where huge breakthroughs have been made. Among them, high-temperature superconductivity research and nuclear fusion research will become the primary technologies during the 21st Century. In the past, the general feeling was that the phenomenon of superconductivity was present only at very low temperatures, but now the highest conversion temperature has reached 125K (-148°C) or even slightly higher. Moreover, the discovery of the phenomenon of superconductivity and the invention of superconducting materials will play an enormous role in the overall technological revolution and industrial revolution. If superconductive power transmission is achieved, there could be a 15 percent reduction in power transmission losses, so breakthroughs in superconductivity research could generate enormous might.

Third, in the area of new advances, an understanding of life at the molecular level has had an enormous impact on biotechnology as a whole, and the 21st Century will be the century of biotechnology. An indication at present is the appearance of super-drugs, super-plants, and super-animals. There are two definitions of super-drugs. One involves recombinant DNA at the molecular levels and uses genetic engineering to synthesize new drugs. It is highly selective, having a selectivity 1 million times greater than common drugs. So-called super-plants have three characteristics, reversal resistance (resistance to disease, tolerance of low temperatures, and drought resistance), increased yields, and superior quality.

The development of the biological sciences has turned many fantasies into realities. In the area of new S&T progress, there have been major advances in micro technology, information technology, space technology and space science, energy resources, and so on.

II. The Present Status and Role of Science and Technology

S&T are now beginning to move to center stage in the world and the new technological revolution is now expanding more quickly in an omni-bearing fashion into all realms of human society and generating an epoch-making revolution in human culture.

S&T have become a force of production in economic development, and they are the first force of production. The development of S&T not only affects the rate of economic development but also causes structural changes. In the 1920's, some 60 percent of the production costs of the automobile industry were for materials and energy resources, whereas materials and energy resources account for just 2 percent of costs in the 1980's. At the same time, the development of S&T has caused a shift in industrial structures from labor-intensive to capital-intensive forms and then on to technology-intensive, which led to the development of the knowledge-intensive form, which is high-tech industry. The reason is that S&T can create the highest added value, so high-tech industry can be called a type of scientific technological industry. Many multinational enterprises are now changing their enterprise development strategies, the most obvious case being Japan. They have proposed a need for a transition from manufacturing groups to thinking groups, referring to the continual ascertaining and thinking of how to produce new products and new technologies. Enterprises must convert

price advantages and quality advantages into technological advantages. In 50 of Japan's big enterprises, investments on R&D exceed investments in equipment in one-third of the enterprises because they have used technology to "pan" for developing new products.

S&T are essential for a strong army, the Gulf War being an obvious example, an example of high-tech warfare. Modern warfare has entered a new era. Technology has transformed tactics and the original concept of so-called "hand-to-hand combat" has been replaced. High-tech warfare is sea-land-air omni-bearing three-dimensional electronic warfare, so preparations for modern warfare certainly require high-tech. If one is backward, he will take a beating and be bullied.

Everyone understands that since the Earth is so big and has so many resources, social development depends on high-tech for coordination. The security of a nation, which includes the military, economy, society, environment, and so on all depend on advanced S&T to provide guarantees. In a sense, S&T can be viewed as the propulsive force in social development and an important factor that promotes coordinated development of society.

In addition, modern S&T are becoming an increasingly important point of concern in foreign relations and politics. Developed S&T activities can exert a huge influence in politics. Overall, if the status and role of S&T can be overstated somewhat, the technological revolution is now shaping the entire world. The development of S&T have changed popular consciousness, understandings of the concept of development, and understandings of the essence of wealth and changing enterprise tactics and national strategies.

III. China's Strategic Countermeasures

In the 1990's, the intersection of centuries, all nations of the world and in particular the primary developed nations are judging the hour and sizing up the situation, readjusting their S&T policies, and redeploying the focal points of their high-tech development. Because of differences in national conditions, the focal points of readjustment in each country vary, but all have a common objective, which is to reinforce competitiveness and increase their overall national strengths. All countries are increasing their investments in S&T for this reason. Comparing S&T budgets for 1990 with those for 1989, for example, there was an increase of 7.4 percent in the United States, 5.7 percent in West Germany, 7.1 percent in France, and 5 percent in Australia. Besides increasing investments, they are also encouraging enterprises to invest while at the same time attracting foreign investment and undertaking international cooperation.

Facing the new situation in world S&T development, the CPC and the state in China have also formulated the corresponding S&T development strategies.

First, there must be a full understanding of world development trends and the challenges that China faces. At present, China is facing three main challenges, the challenge between nation and nation, the challenge between system and system, and the challenge between existence and development. How should China's national policies be formulated? In three sentences: the 'four basic principles' are the foundation of our nation, reform and opening up is the way to make China powerful, and science and technology are the source of national prosperity. Practice has provided full illustration that there are now continual improvements in the understanding of S&T by the entire CPC and all our people. Comrade Deng Xiaoping said that S&T are the first force of production and that problems are ultimately resolved by relying on S&T. Comrade Jiang Zemin has pointed out that promoting S&T progress is an historical task of the entire CPC and all our people. The national policy of relying on S&T progress an improving the quality of laborers to invigorate our national economy has now been gradually achieved at different levels and in different areas in all fields and all regions.

Second, there is China's S&T development strategy. The formulation of China's S&T development strategy should mainly be based on two points. One is that we must observe the laws of S&T development and the situation and characteristics of integrating S&T with the economy. The second is that we must adapt to our own national conditions. Under guidance by these two points, China's S&T development strategy is now gradually being perfected and we have basically determined three levels and six major plans. The first level is focused on the primary battlefronts in our national economic development and placing 60 to as much as 70 percent of our S&T personnel onto the main battlefronts to do their work. At this level there are the "Plan to Attack S&T Problems", "S&T Achievements Extension Plan", "Spark Plan" (which includes the "Plan To Use S&T To Support Poor Areas", the Ministry of Agriculture's "Bumper Harvest Plan", and the State Education Commission's "Setting the Prairie Ablaze Plan". The second level is high-tech R&D and establishing high-tech industry. The "863 Plan" we formulated concerns R&D while the "Torch Plan" concerns the establishment of high-tech industry. The third level is basic research. It can be called our strategic resource and may play a major role in future economic development, personnel training, and the overall development of new views and new ideas.

The six plans include:

1. The Plan To Attack Key S&T Problems. The Plan To Attack Key S&T Problems during the Seventh 5-Year Plan included more than 760 projects and over 4,000 special topics, and the tasks for 90 percent have been completed. In terms of the S&T progress awards during 1990 alone, the total economic benefits exceeded 30 billion yuan.

2. The State S&T Achievements Extension Plan. Not long after this plan appeared, the primary objective was to accelerate the extension of S&T achievements and

increase the utilization rates of achievements. At present, the progress situation for this plan is excellent and the prospects are substantial.

3. The "Spark Plan". This plan was mainly formulated to extend appropriate technology, establish appropriate enterprises, train skilled S&T personnel, and so on in rural areas. It was welcomed and supported by China's vast rural areas and it has received the attention of international organizations, which consider it to be a very good route for dealing with bipolarization and unbalanced economic development in developing countries as well as the social problems that arise in the development of backward rural areas.

4. The "Torch Plan". This was formulated to promote the development of high- tech industry and achieve the "commercialization of high-tech achievements, the industrialization of high-tech commodity production, and the internationalization of high-tech industry development".

5. The "863 Plan". This mainly concerns high-tech research.

6. The Basic Research Plan. This is now being discussed in the relevant state major basic research projects.

Third, there is reform and development of the S&T system. Our S&T development must adhere to the spirit of reform. Reform is mainly reform of S&T operational mechanisms. One, we must change the allocation system and shift from depending entirely on the "emperor's grain" allocation system. Two, we must open up technology markets, enable S&T personnel and S&T achievements to be understood by users and accepted in the market, and enable S&T to integrate closely with production realities.

At present, the new technological revolution has pushed competition of comprehensive national strengths among all countries to an extremely fierce pace. We must increase our sense of the urgency of the era and our sense of historical responsibility, raise the S&T consciousness of our entire nationality, liberate ideology, open up and advance, use reform to spur development, intensify reform during development, have an enthusiastic spirit, spare no effort and go all-out, and strive to reduce our lag behind the developed nations over the next 20 years. The Chinese nationality will certainly be able to stand tall in the forest of the world.

Management of National Key S&T Projects Discussed

92FE0310B Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 6, Nov 91 pp 7-9

[Article by Weng Yannian [5040 1693 1628]]

[Text] China began organizing its national key S&T projects during the Sixth 5-Year Plan period. After implementing two 5-Year Plans, a wealth of experience has been gained. Today, it is possible to consolidate past experience and propose a complete and practical operation system for the national key S&T projects so that the formulation and implementation of the projects may be carried out better. This author participated in the entire organization and management of biotechnology, No. 71 of the national S&T projects, during the Seventh 5-Year Plan period, and wish to share some of the experience with colleagues in S&T management.

I. Decision Process in Establishing the National S&T Projects

The national key S&T projects are development projects of the nation. The selection criteria depends on the urgency in the national economy and social development. The selected projects should meet one of the following three criteria. First, the project should be highly significant for the national economy or social development. Second, it should be first rate in domestic technical level; some should also be aimed at advanced international standards. Third, the project should help the technical improvement of traditional industry or the development of new enterprises.

The national key S&T projects are proposed by the various industrial departments and evaluated by the State Planning Council and the State Science Council. In order for the decision-making process to be scientific, institutionalized, and feasible, we recommend that the process contain the following three steps:

1. Establishing a national key S&T project

A national key S&T project investigative research group with up to 10 members is formed from experts and management cadres of relevant departments. Each proposed project is studied for up to six months. Each group is allocated a certain amount of research funds by the state. After the study is finished, the group shall submit a report to the state.

2. Evaluation of the key S&T project

A discussion and evaluation group consisting of up to 10 experts and management cadres shall be formed. Members of the research group above all shall not be included as a member of the evaluation group. The evaluation group shall conduct a feasibility evaluation on the proposed project and submit a feasibility report. The feasibility report should address each issue raised in the research report and serve as a basis for next-step decisions.

3. Deciding the national key S&T projects

The general state planning department and the state S&T management department shall make a preliminary decision based on the feasibility study report and formulate a national key S&T report for final approval and decisions by the State Council.

II. Operation System of National Key S&T Projects

Based on the experience of the Seventh 5-Year Plan, the main problem of the system is how to eliminate interference from the departments and select the units that will really assume responsibility for the project. The way to overcome departmental interference is to give the decision-making power for selecting the units to the project committee and not to the department.

The project committee may be formed with some the experts and managing cadres of the research group and evaluation group of the key project. The committee should have no more than 20 members. The members should be hired by the State Planning Council or State Science Council. Based on the task and goal of the project, the project committee analyzes the subject and topics and determines the responsible units according to an established procedure. The project committee answers to the superior department that hires them and is supervised by that department. The project committee assigns the evaluation of proposed topics to a group of experts and selects the optimal units to take on the project.

For some key projects continued from a previous 5-Year Plan where the responsible units were judged to have completed their tasks, the project committee may decide to have the units continue the key projects without going through the step of expert group evaluation.

Once the units are chosen for a key project, the right to organize and implement the project will be transferred from the national key S&T projects to the responsible department and committee. The department and committee will then enter a contract with the units chosen to do the work and conduct the day-to-day management of the project.

III. The Three-Stage Management of the National Key S&T Projects

In the past, there were too many management layers in the national key S&T projects. There was the national project integration department, the project organization coordination department, the project-in-charge department, the participation department, the task-in-charge unit, the subtask unit, and so forth. The large number of management layers have artificially caused administrative complications. Efficiency was lowered because of the dependence on other units. A simplification of the management structure is imperative. The national key S&T projects will have a three-tier management model:

1. Project management

The department in charge of the project will organize the implementation of the tasks in the project. An annual allocation will be made according to the contract. Progress in the tasks will be monitored and evaluated. Based on the evaluation, the tasks may be modified. Each year, the department in charge will submit an annual report by the end of February to the integration department detailing the progress made in the previous year.

2. Task management

The unit in charge of the task will organize the implementation of the special topic subtasks. An annual allocation will be made to each subtask according to the contract. Progress in the subtasks will be monitored and evaluated. Based on the evaluation, the subtasks may be modified. New special topics may be added if the goals of the task require it. Each year, an annual report will be submitted to the project by the end of January detailing the progress.

3. Subtask management

The units in charge of the special topic subtasks are the basic units of the national key S&T projects. Each special topic may have one or more units working on it. When more than one unit is working on a subtask, there must be a responsible special topic unit and a responsibility system. The responsible unit has the right to make necessary adjustments based on the situation in order to ensure the completion of the mission. If the other units are not in agreement with the adjustment, they may appeal to the unit in charge of the task. The unit responsible for the special topic subtask must submit an annual report by the end of December each year.

IV. Dynamic Management of the National Key S&T Projects

Based on the execution of the Sixth and Seventh 5-Year Plans, the 5-year cycle has the following disadvantages: (1) Because the projects began at the same time, the deliberation and organization of the projects were somewhat rushed and were not done very carefully. (2) Because the final evaluation of one 5-year plan occurred at the same time that the next 5-year plan stated, these two time-consuming efforts interfered with each other and could not be given adequate attention. (3) In terms of results, a large number of results came out every 5 years. The concentrated production of results was detrimental to the proper promotion and utilization of the results. Because of these shortcomings, we recommend that the national key S&T projects be made the main arena for S&T serving the national economy. From a systematic approach, a set of stable, workable operation mechanisms should be established and the work should be assigned to a stable institute such as a national foundation. The previous practice of producing a batch of results every 5 years should be changed so that each year there are some projects started and some projects completed. Each year, some key results will become available for application in the national economy. In this manner, a dynamic S&T system will be formed to promote the development of the national economy and society. To maintain the vigor of the key projects, the competition mechanism must be adhered to from the beginning to the completion.

As described earlier, the completion mechanism was introduced when the responsible units were chosen for the projects. Once selected, the units cannot take the job for granted. By executing a dynamic contract, the competition mechanism can be followed thoroughly over the entire process. The main approaches are: When the units chosen for the key projects carry out the task seriously and make significant progress, the department-in-charge may increase their annual allocation within the range of annual budget adjustment. In the meantime, 5 percent of the money may be taken from the key project budget and used as awards for outstanding contributors. For units that fail to accomplish the annual targets without acceptable justification, the units will be given a warning and have their budget reduced. If no improvement is seen in the following year, their status on the key projects will be eliminated (contracts terminated) after a review process. For units not on the national key projects which excelled in similar work, the department-in-charge has the right to switch the key project units after a review process.

V. Management System of the National Key Projects

In the national key projects, should China practice the management system that combines experts and management cadres or the expert committee management system? Based on the results in the Seventh 5-Year Plan, the management system that combines experts and management cadres seems to be better. This is because both the experts and the management cadres have their strengths and shortcomings. By combining the two, one's strengths may compensate for the other's weaknesses. Experts have their strength in academics and are familiar with domestic and international development in the area of their research. They should, therefore, speak on the scientific and research contents of the project, the feasibility of the goals, and the evaluation of the research results. The experts should play a full role in the investigation and deliberation of the key topics, the content and goals of the project, the evaluation of the proposal, the evaluation of the task, and the verification of the results. The management cadres, on the other hand, are experienced in organization and management and have a higher ability for coordination and policy. They are better at macroscopic synthesis and determination and have a deeper understanding of the national economy and the overall situation of the special area. Therefore, management cadres should play a full role in the selection of the tasks, the setting of goals, the organization and implementation of the key projects, the coordination of the tasks, the allocation of money, and other day-to-day management jobs of the projects.

Of course, the role of the experts and the management cadres in the same management process cannot be totally separated. In many cases, they complement each other; the only difference is that one or the other tasks take the lead in different management processes. It is much better to let both the experts and the management cadres show their initiatives instead of just having the initiative of only one group. In the actual practice of five years, the experts played a full role in some business decisions; whereas, the management cadres handled some of the day-to-day management matters, including task coordination, distribution of funds, and other business. This arrangement allowed the experts to devote more time to research and academic activity. The experts welcomed this practice. The close cooperation between the experts and cadres and the opportunity for each group to use their specialty ensured smooth progress in the key projects.

VI. The Division of Work and Connection Between National Key S&T Projects Should Be Properly Handled

Today, major national key S&T projects include the national key S&T projects, the national high-tech projects, the "Torch Plan" projects, the "Starlight" projects, and the national fundamental science projects. Each of these national projects has its own mission and emphasis. Under an overall grand plan, each of these projects plays its role in forming a coordinated national science and technology plan to promote China's economic and technological development. The system today, however, caused departmental fragmentation, lack of coordination and connection, and each project marching to its own drummer. From the point of view of the whole national interest, this is less than satisfactory. Based on the experience of actually working in these projects, we wish to discuss the connection and continuation problems between the high-tech portion of the national key S&T projects and the national high-tech projects. Since the national key S&T projects are the "main arena" for S&T to serve the national economy, its mission is to solve major S&T problems in the development of the national economy. In terms of time, the key S&T projects emphasize those key technologies that would promote national economic development in the next five to 10 years. The national high-tech project, on the other hand, is to track a limited number of target technologies in the international arena with an eye toward having an effect at the end of this century or early in the next century. In other words, the national high-tech project should emphasize the deployment of mid- to long-term research of major high-tech problems and to avoid repeating the national key S&T projects in the "main arena." A reasonable model would be for the national high-tech projects to arrange more mid-term and long-term research. After these projects obtain laboratory research results, the results will be transferred to the national key S&T projects for intermediate testing. After intermediate testing, the projects should be transferred to the "Torch Plan" for industrialization in order to gradually form a high-tech industry in China.

Zhang Cunhao's Views on Basic Research

92FE0155D Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 18 Oct 91 p 2

[Article by Peng Dejian [1756 1795 1696]: "Basic Research Is the Vanguard and Fountainhead of High and

New Technology—A Visit With National Natural Science Foundation Chairman Zhang Cunhao [1728 1317 3185]"]

[Text] Recently, the National Natural Science Foundation Chemical Sciences Department Fund Evaluation and Natural Science Award Reappraisal Conference was held at China Science and Technology University in Hefei. The 63-year old Academic Committee member and famous physics and chemistry professor Zhang Cunhao, who was recently appointed chairman of the fund, told visiting reporters that we must certainly raise a cry of warning about the importance of basic research and allow all of society to have this common understanding: the development of high and new technology is fundamentally impossible without basic research, while basic research is an effective way to train high-level personnel. He feels that the CPC Central Committee's emphasis that S&T are the first force of production requires all the people of China to increase their understanding of S&T. This includes increasing their understanding of basic research. Reinforcing S&T work should include strengthening basic research (as well as applied basic research) work.

Professor Zhang said that the traditional concept considers basic research to be an essential foundation of knowledge for utilizing and transforming nature, a backup force and reserve for S&T and economic development, and so on. This is correct, of course, but it is not enough. In fact, basic research at present is far from being the third level of S&T development and has now become a vanguard and fountainhead for most important new inventions and new technologies. Major breakthroughs in basic research open up people's understandings and capabilities and affect the social development process from many aspects, and they often guide the opening up of new research realms. The formation of new-tech industry has a revolutionary impact on high and new-tech and economic development. During the entire process of development of high and new-tech realms that are now at the leading edge of disciplines, every stage, every link, and every difficulty still depends to a substantial extent on breakthroughs in basic research. This was true for research on high- temperature superconductors, for example, in the new discovery of spherical C_{60} superconducting materials during 1991 and other things. Thus, a cycle is formed from basic research to applied research and on to development and the formation of an industry, and it is being greatly shortened. It can be said that without continual and rapid breakthroughs in basic research, there could be no flourishing development of high- and new-tech. Moreover, the development of high- and new-tech also promotes technical upgrading and exploitation of potential in traditional industry and promotes enterprise progress. For example, the development of energy conservation and new energy resources is becoming increasingly dependent on new materials, new technologies, and new techniques, and all of these things depend on basic research.

"For training high-level S&T personnel, basic research is even more effective and most important." Professor Zhang paused for a moment and shifted the topic to qualified personnel, something that most concerns people. Our ability to train high-level S&T personnel is the key to whether or not we can occupy a high point in S&T development during the next century, and it is an important issue in competition of overall national strengths and economic development strategies. There are various ways to train high-level S&T personnel. Applied research and development work can also train skilled personnel, but personnel who have been tempered and trained through basic research have a broader view and stronger adaptability. Comrades involved in basic research are usually high-level teachers with good projects who have undergone strict basic training, have broad and profound knowledge, and are broadminded and can make achievements in the discovery of new phenomena and new laws, establish new concepts and new areas, and explore new applications. Many senior-level accomplished personnel in the developed countries have experience in basic research. One might ask, how have the developed nations been able to develop high- and new-tech so quickly and develop their economies so quickly? There is a substantial relationship here with the movement of large numbers of skilled personnel who have grown up via basic research into applications and development research posts. For the past several years, the basic research work that has been funded by the Science Fund has enabled about 25,000 graduate students to participate in practical activities and trained over 300 post-doctoral students, over 1,500 Ph.D.'s, and more than 15,000 master's students. This has had a profound impact on promoting the training of high-level S&T personnel in China. They will play key roles in China's basic research and have roles as academic leaders in high-tech research, applications and development research, and industrial and agricultural production. The facts have proven that using basic research to train high-level S&T personnel is also a very effective route in China.

There is now an urgent need for high-level qualified personnel in applications and development research and even in production and management. The source of a substantial portion of them must depend on basic research for training. The idea that personnel involved in basic research can only do research and are incapable of management is a type of prejudice. In fact, many high-level management personnel in foreign countries are often experts in a particular field. Management levels in many of our production departments and administrative departments are not high and this is related to the lack of the necessary experts and the necessary personnel who have been trained through basic research.

Professor Zhang said in closing that arrangements for basic research in China's S&T research are deployed as a third level. Actually, as for its function and role, it is not simply limited to the third level but instead permeates the primary and secondary levels. Thus, when we have a

profound understanding that S&T are the first force of production and stress a focus on work at the primary and secondary levels, we also should pay the proper attention to basic research at the third level, which of course includes increasing expenditures on basic research as much as possible. The primary task of the National Natural Science Foundation is to support basic research. We must be conscientious and meticulous in doing good work at the third level and we must more consciously reinforce linkages and coordination with the first and second levels and make the proper contributions to the development of science in China and to the achievement of our second strategic objective.

Economic Development and S&T Progress in the 1990's

92FE0276E Beijing GUANGMING RIBAO in Chinese 29 Nov 91 p 3

[Article by Zhang Yongze [1728 3057 3419] and Zhang Haiyu [1728 3189 7625] of China People's University]

[Text] China's economic development task for the 1990's is to achieve the second strategic objective in modernization and construction tasks and raise the overall quality of our national economy to a new level. The primary requirement for achieving our second strategic objective during the next decade is: on the basis of major efforts to improve economic results and optimize the economic structure, quadruple our GNP at constant prices by the end of this century compared to 1980, which will require an average yearly GNP growth rate of about 6 percent over the next 10 years. It will be impossible to attain this rate of economic growth, which is also relatively high on a world scale, if we merely continue to rely on large-scale inputs of the factors of production to support economic development during the 1990's. In other words, if we continue following old development models to develop China's economy we will be restricted by many real factors and economic development will become very difficult. A more feasible alternative is to select a route dominated by internal expanded reproduction that shows concern for the quality of results of the inherent quality and results of economic development that will enable us to achieve long-term, stable, and coordinated development of China's economy.

One of the keys to selecting this results-type economic development path that is concerned with economic results is making full use of S&T progress to promote stable development of our national economy. The reasons are that:

First, S&T progress is an important way to promote rationalization of China's industrial structure during the 1990's. One of the keys to long-term coordinated and stable economic development is rationalization of our industrial structure. China's irrational industrial structure has now become an impediment to economic development. Supply shortages in the energy resource, raw materials, communication and transportation, and other basic industries are severely restricting economic development. This is due on the one hand to inadequate investments and slow growth in basic industry and on the other hand to the technological backwardness and waste of resources in other industries. For example, China consumes three times more energy resources to create $1,000 in GNP than does the United States, seven times more than Japan, and two times more than India. Steel utilization rates are generally 80 percent in the developed countries but only about 60 percent in China, and this has invisibly exacerbated the degree of shortages in supplies of energy resources, raw materials, and other things to basic industry in China. Based on the period that can be forecasted during the 1990's and China's energy resource supply possibilities, China's economy may double [in gross value of industrial and agricultural output] during the 1990's, but it will be difficult to double supplies of many energy resources, for example petroleum, coal, and our other most important energy resources. How can comparatively less growth in basic industry support doubling of the entire economy? We must use technical progress to promote rationalization of our industrial structure. There is no other way.

Second, using S&T progress to develop emerging industries and raise the elevation of the industrial structure is the key to long-term growth of China's economy during the 1990's. After the war, the successful experiences of economic development in many countries showed that developing emerging industry and raising the elevation of the industrial structure is the most rational route to long-term stable economic growth in many countries as well as the primary way to increase the overall strength of a nation's economy. For this reason, economic development during the 1990's must rely on S&T progress and raise the elevation of the industrial structure.

Third, only by relying on S&T progress will we be able to raise enterprise productivity, increase enterprise economic results, and provide an excellent foundation for development of the entire economy. Economic development during the 1990's must be established to an even greater extent on improving economic results in existing enterprises. Moreover, improving enterprise economic results cannot be separated from technical progress, either in developing new products or in raising productivity.

Concretely speaking, we should focus on these points during the 1990's to promote S&T progress and ensure long-term stable and coordinated development of our national economy:

1. Use system innovation to promote technical innovation. Carry out further reform of the economic system. In particular, we should use system innovation to plant technical progress mechanisms into enterprise management mechanisms. This should be a focus of enterprise reform during the Eighth 5-Year Plan. This can be done via reform at three levels. One, solve the problem of the motive force for development within enterprises so that

enterprises truly have self-development and self-accumulation mechanisms. Second, find ways to strengthen market competition mechanisms in the external environment of enterprises. Third, reform the existing investment system, "store wealth in enterprises", and make enterprises the true main aspect of investments.

2. Formulate correct and appropriate technology policies, form a technology system with Chinese characteristics. A technology system with Chinese characteristics should be established on China's national conditions. China is a country with abundant manpower resources but relative shortages of capital and natural resources. For this reason, China's technology policies should at least emphasize the development of labor-intensive technology for a substantial period of time and use labor-intensive technology as a foundation for forming China's technology system. China now imports large amounts of technology from foreign countries, much of which has not been properly digested and absorbed to adapt it to China's resource conditions. Technology from foreign countries, especially technology from the developed nations, is usually established on a foundation of shortages of manpower resources and is generally characterized by being capital intensive and technology intensive. In most cases, it does not conform to China's national conditions. If we fail to start with reality and fully absorb and digest, redevelop, and recreate these technologies, it will be hard for us to form true industrial advantages regardless of the type of technology or type of product.

3. Deal correctly with the relationship between basic technology and high technology. It should be acknowledged objectively that a "binary structure" exists at present in China's technology. On the one hand, China has incisive technology that can be compared favorably with the most advanced nations of the world and for which we can feel proud. On the other hand, in the area of the large amount of basic civilian technology, our technology is extremely primitive. This "binary" structure is extremely unfavorable for the normal development of China's industry. We often pay too much attention to developing incisive technology while neglecting to develop basic civilian technology. We have neglected this point in personnel training, scientific research funding, the scientific research system, and other areas. For example, on the one hand there is overstaffing in many scientific research organizations while on the other hand plants often lack top-notch engineers, designers, and so on. Economic and S&T development in many countries shows that high S&T based on backward technology is inevitably water without a source.

4. Focus on education, especially professional education and education in the engineering disciplines, train large numbers of structurally rational qualified personnel. We should use education and training to put China's extremely abundant manpower resources to the most appropriate and rational uses. This is the most realistic route for economic development in China during the 1990's.

5. Strengthen macro technology management. At present, we should strengthen industrial technology management and use measures like issuing production licenses and compelling certain enterprises with low management and administration levels and poor product quality to raise levels and improve management. We also can consider using planning measures to ensure that certain things in short supply like energy resources, materials, capital, foreign exchange, and so on flow toward enterprises with relatively high management and technical levels to truly support the best and restrict the inferior.

6. Protect intellectual property rights, encourage the establishment of all types of risk enterprises, promote industrialization of technology. Protecting intellectual property rights can encourage people to invent and innovate and promote the rapid conversion of S&T into forces of production. Thus, we should formulate a complete policy system to protect intellectual property rights. At the same time, we should adopt more preferential policies in systems, capital, taxation, and allocation to encourage the development of S&T risk enterprises. Developing S&T risk enterprises is one way out for China's high-tech industry.

Stimulation of More Basic Research in China

92FE0401A Tianjin KEXUE XUE YU KEXUE JISHU GUANLI [SCIENCE OF SCIENCE AND MANAGEMENT OF SCIENCE AND TECHNOLOGY] in Chinese Vol 13 No 2, Feb 92 pp 46-48

[Article by Li Guoren [2621 2654 0088], Hunan Province Academy of Social Sciences: "Summary Views on the Status of Basic Research in China"]

[Text] In modern societies, the development of basic research has become a scientific endeavor in which all society is involved. It is the foundation for technological progress, the underpinning for economic development, a window for international exchanges, and a cradle for the nurture of human talent. It also plays a supporting role in the building of national material and spiritual civilization. Strength in basic research is an important determinant of a country's overall national strength, and it is also one of the basic requirements for a nation's modernization. From the tortuous road of successes and failures that the world and China have taken in their development during the past several hundred years, we realize clearly that there are countries in the world that do not do basic research, but that there are no powerful countries that do not do basic research. A country that does not assimilate the world's newest scientific thinking cannot observe and deal with problems from the heights of world scientific accomplishments. It is a country lacking scientific and technical strength that cannot modernize. It is in this connection that this article will

summarize the main views that academic circles have put forward in various regards about basic research.

1. Present State of and Problems With Basic Research

One view maintains that China's basic research corps is facing two problems. The first is that it is getting old. It is facing a "hiatus." A survey of 10 fairly large scientific research organizations shows more than 60 percent of the researchers to be 49 years old or older. This is 95 percent of the high ranking researchers. Those 35 years old or less numbered only 18 percent. Ten years from now, virtually all of the key researchers will have retired, and today a void exists between the 35 and 45 year old groups. Facing a hiatus, basic research will enter the 21st Century with a corps whose average age is 60. Second is poor cohesiveness and a decrease in new blood. A survey done by organizations concerned on graduate students entering the basic research corps in recent years shows at least 75 percent lacking confidence about their future careers. Their greatest desire is to go abroad to study, not to remain in China to do scientific research work. In addition, a Chinese Academy of Sciences survey of seven research institutes shows that only 50 percent of the 566 graduate students who have entered these institutes since 1980 are still working there. Of the more than 2,000 graduate students lost in 1987, an overwhelming percentage were those who had studied basic research. Furthermore, the percentage of college students sitting for examinations to become graduate students has steadily declined. For some basic research courses, no one makes any inquiries at all.

Another viewpoint suggests that, for various reasons, numerous worrisome events have occurred in the basic research field in recent years. Examples include a shortage of funds, a loss of human talent, and a decline in major achievements. In many leading edge fields in which rapid advances have been made internationally in recent years, we lack the manpower resources and the financial resources to continue to keep up. In some research fields in which we formerly held the advantage, we now find ourselves lagging. It must be said that this situation in the basic scientific research field today is very ill suited to the constant changes taking place in the development of modern science, as well as the urgent desire for early modernization of the country's billion people.

The third viewpoint holds that with the intensification of reform of the science and technology system during the past several years, increasing numbers of scientific and technical personnel have headed for the main battleground of economic construction. They are advancing the link between science and technology and the economy, and this movement is in the right direction. However, for various reasons, basic research is relatively overlooked. The main problems existing in basic research work in China today are funds and human talent. At the present time, investment of funds in basic research and in applied basic research in China accounts for only 7 percent of the total investment in scientific research. This figure is far lower than for most countries in the world. The National Natural Sciences Fund provides approximately 100 million yuan annually for basic research and applied basic research projects. Because of the small amount of funds available, many projects are not funded. Thus, the financial assistance rate and the intensity of assistance are both too low. Each year we receive 12,000 requests for project financial assistance, but only 3,000 actually receive assistance. This is approximately 25 percent. About 75 percent receive no financial assistance. The intensity of financial assistance was 28,000 yuan per project in 1986, and 29,000 yuan per project in 1987. Despite the slight year-by-year increase, less money was actually available for basic research and applied basic research because of the rise in prices.

The human talent problem provides even greater cause for alarm. Since basic research work takes a long time, is fraught with risks, and can scarcely produce economic returns within a short period of time, young people "bolt away" from it into other professions. The lack of continuity in the basic research corps, and the loss of human talent has reached a point where it is difficult to go on.

The fourth point of view maintains that a tendency existed for a long time about scientific research that emphasized applied research while slighting theoretical research, and that emphasized the present rather than the long term. Driven by this frame of mind, there was either no place for basic research, or was elbowed aside. If undertaken at all, it was impossible to move ahead boldly and with assurance. No climate favorable to basic research took shape. The several policy swings that have occurred since founding of the people's republic also delivered very serious blows to China's basic research. In addition, the tendency toward one-sided pursuit of economic returns in the management of scientific research that has come about in today's commodity economy also creates certain psychological pressures and burdens on scientific research personnel doing basic research. Many personnel engaged in basic research experience a feeling of loss because society does not hold them in high esteem or understand them. Furthermore, the country fails to take the total situation into account and do unified planning of basic research work. No overall plan of action exists for the development of academic disciplines; a unified coordination mechanism for plans at different levels is lacking, and a situation of numerous administrative heads, a lack of scientificness, and a lack of democracy exists in decisions made on major scientific issues.

2. Reasons For Impairment of the Position of Basic Research

One view maintains that several fluctuations have taken place in basic research during the course of developing science since China's liberation. At various times, a basic theory wind prevailed during which basic theory was respected and honored. Mostly however, it was a dislodging wind that blew in which basic research was

ignored when applied research was emphasized. The intervals between the two winds were few and of short duration. Naturally, this hurt the healthy performance of basic research. Furthermore, since the country's scientific research system has long been planned, produced, and operated within the framework of the national planned economy, inevitably the basic research system bears the imprint of the old system. Basic research organs have long been isolated; their so-called self-perfection lacks a sense of competition and organic vitality. With the implementation and intensification of science and technology system reform in recent years, the situation has changed. Today, 75 key national laboratories have been founded, but they are still a fairly long away from the paradigm for the country's basic research objectives.

The second view holds that the reasons for impairment of the position of basic research are very complex. They include the genuine shortage of financial resources, scientists' relatively poor working and living conditions, and such objective factors. Nevertheless, in subjective terms, it has been skewed perceptions that have been substantially responsible for certain mistakes on the part of decision making units. First of all, in turning all science and technology forces mostly toward service in building the national economy, some comrades fail to understand the relationship between basic research and applied research. They are anxious to gain economic returns from scientific research. Economic returns must be considered in scientific research, it is true, particularly for developing countries. The development of more technologies having a short period between the time the technology is developed till the time that it is used in production, that are of a technological level suited to medium and small-sized enterprises as well as township and town enterprises, and that produce speedy economic results is right considering the country's circumstances. However, just as soon as basic research efforts are loosened or weakened, applied research is bound to suffer. Science and technology forces that can serve the national economy are weakened. Second, some comrades leave technological progress to imports. They feel with regard to basic research that "a slow remedy is of no help for a critical illness." They would rather get instant gratification. Driven by this guiding thought, they prefer repeated purchases abroad of whole plants abroad rather than invest in basic research. They little realize that the economic development of a major country requires having one's own basic research forces; otherwise, there will be no underpinnings for the development of science and technology, and the day will come when objective laws wreak punishment.

3. Actions For Bolstering Basic Research

Action 1: Organize a crackerjack basic research corps, concentrating limited manpower and financial resources on major goals to score breakthroughs in certain basic research fields. Then, devote many years of effort to the gradual formation of a benign cycle in China in which basic research promotes economic development, and economic development supports basic research.

Action 2: Draw up a complete strategy and policies, defining fields for priority development. The key to ensuring sustained development of basic research lies in policy continuity, and unified strategic thinking is a prerequisite for ensuring policy continuity. Maintenance of a rational percentage of investment has been a general international experience; China should also follow this pattern. At the same time, it should change sole reliance on national treasury disbursements to a system in which "payments from the state treasury are primary but are supplemented by social support of various kinds." International cooperative exchanges are an important means for conducting basic research. We must open the country's doors further and take to the world stage to raise our standards and win gold medals in international competition.

Action 3: Adoption of tilt policies as basic research needs warrant. No unit can buy the results of basic research at will; no unequivocal ownership of such results is possible; and research results cannot become a commodity. Basic research does not enable the research organization to walk "on yet another leg" in the way that research and development organizations do, i.e., to make income, improve employee benefits, and develop new sources of funds by providing services for compensation. Thus government has to make a tilt in advance regarding disbursements to be made for basic research and the benefits that employees are to receive when it formulates science and technology policies so as to attain internal fairness in the world of science and technology. This is an additional way to obtain continuity in the basic research corps. Ideological and political work must also be done as basic research work and the ideology of contemporary people require in order to increase the ideological consciousness of basic research personnel, enabling them thereby to understand fully the importance and the arduousness of basic research, and to inculcate a spirit of bravery in devoting themselves to the motherland and to science.

Strategy of S&T Resource Management

92FE0155H Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 21 Oct 91 p 3

[Article by Lian Yanhua [6647 3601 5478]: "Strategic Ideas for Management of China's S&T Resources"]

[Text] S&T are forces of production and an important motive force in social and economic development. The most important basis for relying on S&T to invigorate our economy is first of all to strengthen S&T forces, so while stressing reliance on S&T to invigorate our economy we should first of all give greater attention to invigorating S&T. The development of S&T requires specific conditions, the most important among them being one, capital investments, and two, organization and management.

I. Basic Situation of China's S&T Resources

S&T resources mainly include: 1) S&T personnel of a specific quality engaged in S&T activities (laborers); 2) Instruments and equipment as the tools of S&T activities (tools of labor); 3) Basic facilities, materials, reagents, and so on as the material conditions for S&T activities (materials of labor); 4) The activity expenditures as required conditions for S&T activities to create material and spiritual wealth for society (capital); 5) Various types of carriers to record and transmit knowledge generated by S&T activities (information); 6) The sites for creative labor to explore the unknown and the organizational arrangements for mobilizing, coordinating, and managing other S&T resources (organization). A country's S&T resources can be divided into five parts: manpower resources, financial resources, material resources, information resources, and organizational resources.

In 1990 China had 24.32 million specialized technical personnel of all categories, including 11.454 million natural S&T personnel. Total expenditures on S&T activities in China were 30.05 billion yuan, including 13.66 billion yuan from financial S&T expenditure allocations. We spent 12.2 billion yuan in S&T expenditures on R&D, equal to 0.7 percent of our GNP in 1990, and 612 million yuan of S&T loans were actually provided. We had 14,550 major R&D organs, including 5,595 scientific research organs under the jurisdiction of government departments at the county level and above, 1,666 scientific research organs under the jurisdiction of institutions of higher education, and 7,289 technology development organs under the jurisdiction of large and medium-sized enterprises. We had 3,412 natural science associations, including 155 national associations and 3,257 province-level associations. There were 3,288 natural sciences periodicals included in the national unified periodical numbers.

II. Basic Assessment of China's S&T Resources

Since reform and opening up, there has been substantial development of China's S&T resources and they have effectively supported China's S&T activities.

A. Continual increases in quantity, some improvements in quality

In absolute numbers, there have been substantial increases in China's S&T resources during 12 years of reform and opening up. In the area of S&T manpower resources, the total number of natural S&T personnel in units under the ownership of the whole people in 1990 was 2.46 times the 1978 figure and the number of enrolled students in institutions of higher education and polytechnical schools and graduate students was 2.52 times greater. In the area of S&T financial resources, state outlays for scientific research in 1988 were 2.23 times the 1978 figure. In the area of S&T information resources, there have been substantial developments in China's library institutions and publishing institutions since reform and opening up, international and domestic academic exchange activities are extremely vigorous, and there have been substantial increases in the production and dissemination of S&T information. In the area of S&T organizational resources, the total number of R&D organs in governments above the county level and under the jurisdiction of institutions of higher education and large and medium-sized enterprises was 14,550, and we have also invested in building several 100 key open laboratories and several engineering and development centers.

There have also been improvements in the quality of S&T resources that are most prominently manifested in personnel training, scholarly exchanges, the establishment of new types of scientific research organizations, and other areas. For the past several years, there have been great improvements in the educational levels, job title structures, and age structures of S&T staffs. A large number of high-level key laboratories and engineering and research centers have gradually become a backbone force in China's scientific research and technology development. Our linkages with international S&T circles have grown and many high-level scholarly activities are being held in China. Many renowned international scientists have visited China, large numbers of Chinese scientists have gone to foreign countries to participate in research activities, and there have been rather rapid developments in the establishment of scientific databases and on-line search systems. All these things have substantially raised the quality of S&T information resources.

B. Continual readjustment of structures and allocation patterns

A series of measure for reform of the S&T system that appeared since 1985 have promoted intensive reform in different areas including encouragement of personnel circulation, reform of the allocation system, increases in S&T investments, strengthening the decision-making rights of research institutes, promoting international cooperation and cooperation among all types of organizations in China, and so on. At the same time, we have gradually reformed S&T resource management patterns. In the area of personnel resources, one thing is that we have emphasized personnel circulation and implemented bidirectional selection for units and personnel, which has increased the initiative of S&T personnel. A second is an emphasis on continuing education for S&T personnel, accelerated knowledge updating, and focused training of middle-aged and young S&T personnel. In the area of S&T financial resources, the state's S&T investments have shifted from a structure dominated by expenditure allocations in the past to a structure that is focused on subsidizing projects in major plans that are urgently needed for national social and economic development with supplementation by administrative expenditures. In management, a project bid solicitation arrangement is being adopted for increasing numbers of projects and some capital has been allocated for scientific management focused on subsidizing basic research work. In the area of S&T material resources, we have

been trying to change the situation of equal allocations and redundant construction and encouraging important scientific research facilities and institutes to open to society, and we have focused on building several high-level research facilities, laboratories, and engineering research centers. In the area of S&T information resources, we have changed the self-enclosed state of scientific research organs and the S&T information system, reinforced collection and analysis of information on market demand, and strengthened the diffusion of S&T information into society. In the area of S&T organizational resources, one thing we have done is to focus on construction of key laboratories to strengthen the organizational system and related capabilities at scientific vanguards, and a second is that we have expended considerable effort to develop research and development organizations in institutions of higher education and enterprises and reinforced the S&T functions of institutions of higher education and enterprises. A third thing is that we have encouraged cooperation and integration of scientific research organs and other social organizations (governments, institutions of higher education, enterprises, financial organs, intermediary organs, design units, etc.), and reinforced the relationships between scientific research organs and society. A fourth is that we have broadly established mass-type S&T organs throughout society like the China Science Association and local science associations, enterprise science associations, technology upgrading organizations, rural specialized S&T organizations, and so on that have caused the structure of S&T organizational resources to develop from being completely independent scientific research organs under the jurisdiction of government departments to fully rational S&T organizational systems for all of society.

C. Overall, we still cannot meet requirements

Overall, China's S&T resources still cannot meet the requirements of society, the economy, national defense, and the development of S&T itself. In quantitative terms, many indicators for China's investments in S&T resources are not comparable to those in the industrial developed nations or even in some developing nations. The number of S&T personnel per 10,000 population and per 10,000 employees is still extremely low. There have been successive reductions for several years in outlays for scientific research as a proportion of outlays from state finances and insufficient investments in S&T resources are becoming one of the factors restricting socioeconomic development. There have been successive reductions each year in the number of scientific research instruments and equipment purchased by scientific research organs are there severe shortages of scientific research facilities and instruments and equipment. S&T forces are very weak in several industries and many enterprises do not have their own R&D organs. There are very few or even no scientific research organs in some important research fields. There are also many problems in the area of the quality of resources, such as the phenomena of personnel faults [duan ceng 2451 1461—geological fault] and overstaffing, insufficient investments of topic funds, reductions in the proportions accounted for in R&D expenditures, severe aging and an inability to upgrade scientific research facilities and scientific research instruments and equipment, difficulty in publishing high-level S&T works, social apportionment and research organs running society, reductions in the personnel and technical reserves in several scientific research organs, and unclear directions, operational difficulties, and reductions in achievements in many scientific research organs, sometimes to the point where that do not have the necessary social functions, and so on.

III. Strategic Ideas for China's S&T Resource Management

Besides maintaining basically stable development of manpower resources in China's S&T resources, the development of other types of resources has been affected by restrictions from socioeconomic development. The primary one is that the state's macroeconomic situation has restricted growth of S&T financial resources, which has in turn affected the development of material resources, information resources, and organizational resources. In addition, China's S&T manpower resources are related to the elevation of two factors, one being elastic growth of our total population and the other being the development situation for educational activities. We should have a sober understanding of this basic structure of China's S&T resources in order to guide the development and administration of S&T resources. First, S&T must be closely integrated with socioeconomic development and greatly promote socioeconomic development before it can receive greater social inputs and develop more itself. Second, the development of the various components of S&T resources cannot be completely synchronized. Fully fostering the role of S&T personnel, making major efforts to train more S&T personnel, and using this to raise S&T levels in society as a whole should be a strategic choice in the development of S&T resources. When formulating industrial policies, we also should give special attention to the development of personnel-intensive industries (such as the software industry) to enable China's fully adequate qualified personnel resources to play a role in scientific research and to be able to be effectively converted into the other resources needed for S&T activities and economic activities. Second, we must stress the combination of all components of S&T resources. In much analysis concerning S&T development, people are often concerned only with manpower and capital inputs and neglect many other factors. It requires special emphasis here on the importance of information and organization. Information production, collection, processing, treatment, and analysis capabilities are the key to success in S&T activities in regard to the collection and utilization capabilities and so on for other resources. Thus, we must strengthen the development and utilization of information resources and organizational resources.

In the area of S&T resource management, two issues are very important. One is the utilization rate of S&T

resources. For a long time, people have called for major efforts to increase S&T investments, and this undoubtedly is extremely important. Another important issue is especially deserving of mention, which is the issue of the utilization rate of S&T resources. Much waste of resources can be found in actual work. For example, many S&T personnel do not participate in R&D activities, so actually they are unemployed but still on the job. Scientific research funds flowing toward non-R&D activities and insufficient scientific research instruments and equipment coexisting with low equipment utilization rates, redundant purchases of equipment, excessive numbers of S&T management organs and levels, which ties up large amounts of S&T resources and delays resource allocation and utilization, low enthusiasm of S&T personnel for their work, and other problems all exist objectively and some have become serious. They should receive the necessary attention. Second is the restructuring of the S&T resource management system. Since reform and opening up, government departments have gradually pulled out of the daily micromanagement of scientific research organs, enterprises, financial organs, and other basic level organizations and are concentrating on considering macromanagement questions. There have been substantial increases in the decision-making rights of scientific research organs and enterprises. They can arrange their own activities on the basis of their own development needs and social needs. There have been rapid increases in the administrative income of scientific research organs during the past few years and continual reductions in the proportion of government allocations. Enterprise and financial circles are now quickly and broadly moving into the development and management of S&T resources. These changes are an indication that changes and shifts are now occurring in the main aspects of China's S&T resource management system and S&T resource inputs, which is that they are gradually moving from the government having sole responsibility for developing the state's S&T activities to all of society having joint responsibility for developing S&T activities. This change has profound strategic significance and is an indication that a new S&T system and S&T resource development and management system that conforms to China's national conditions is now gradually taking shape. This change is a reflection of changes in production relationships within S&T activities and undoubtedly will effectively promote the development of S&T as a force of production.

13th Symposium on Reform and Management's Suggestions on Strengthening National Defense S&T Research

92FE0215C Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] in Chinese No 6, Nov 91 pp 61-63

[Article: "Some Policy Proposals for Reinforcing National Defense Scientific Research—An Outline of the National Research Institute Joint Friendship Association's 13th Reform and Management Symposium"]

[Text] The National Research Institute Joint Friendship Association convened the National Defense Scientific Research Academy and Institute Reform and Management Symposium from 19 to 24 June 1991. There were 65 delegates from 44 national defense scientific research units who attended the conference. The relevant responsible comrades from the State Science and Technology Commission, National Defense Science, Technology, and Industry Commission, Ministry of Aerospace Industry, China Electronics Industry Corporation, and the Luoyang City Government and City Science and Technology Commission were invited to attend the conference. Wang Xiaoping [3769 2556 1627] of the National Defense Science, Technology, and Industry Commission Office Policy Research Office, Dong Jingsheng [5516 0513 3932] and Wei Zhenqiu [7279 6966 3808] of the State Science and Technology Commission System and Management Research Institute, and Luoyang City Vice Mayor Zhao Mingdeng [6392 2494 3397] gave speeches at the conference. Joint Friendship Association secretary Jin Liangjun [6855 5328 3182] and deputy secretary Zheng Zhenxing [6774 2182 5281] attended and chaired the meeting.

The delegates felt that under leadership of the theory that "science and technology are the first force of production" and through adherence to the policies of reform, opening up, and invigoration, national defense scientific research has made gratifying achievements based on the "16 character" principle of ensuring military production and converting to civilian products, and that large national defense scientific research academies and institute had increased the vigor in reform. Mechanisms to integrate S&T with production are now gradually being pushed forward, the management model that integrates plan management with market regulation is gradually taking shape, technology as a unique commodity is participating in market activities and there have been substantial developments of the technology market, and as a consequence there has been considerable improvement of the working and living conditions of intellectuals. Initial results are also being seen in national defense scientific research academies and institutes in the areas of integrating military and civilian products, strengthening abilities to make a transition from peace to war, and stabilizing national defense scientific research staffs. Still, "opportunities and difficulties coexist, as do achievements and problems". We must seek truth from facts, summarize experiences, analyze problems, search for routes and concrete measures to resolve difficulties and problems, and promote in-depth deployments of reform in national defense scientific research academies and institutes.

The Gulf War sounded the alarm for reinforcing national defense scientific research. It attracted a high degree of attention at the highest levels of the state and stimulated a sense of urgency and sense of responsibility on the part of S&T personnel on the battlelines of national defense scientific research. They understand that strengthening national defense construction and accelerating modernization of national defense technology and equipment

are important tasks and that national defense scientific research academies and institutes cannot shirk their responsibility. Moreover, national defense modernization is first of all national defense S&T modernization and tracking advanced international S&T levels to place China in an invincible position in today's complex and frequently changing international situation. Thus, during a period of peaceful construction, to protect and support the national defense S&T staff that has already been put together in China so that it does not become disordered or scattered, besides the state increasing investments and providing policies, in a situation of relatively difficult state finances, taking the route of "guaranteeing the military and converting to civilian products, using civilian products to develop the military", implementing a strategic transition with leadership and plans, and protecting our ability to make a transition from peace to war are correct strategic decisions for modernization and construction of China's military.

At the symposium, delegates from 10 units including Ordnance Industry Institute 201, China Navy Seventh Central Academy Institute 725, Ministry of Aerospace Industry Second Academy Institute 23, Ministry of Machine-Building and Electronics Industry Institute 18, PLA Antichemical Warfare Institute, Ministry of Aerospace Industry Center 014, and others described experiences in guaranteeing the military and converting to civilian products and using civilian products to develop the military, strengthening capabilities for shifting from peacetime to war, promoting self-development of research institutes, and maintaining national defense scientific research reserve strengths. The basic characteristics of these experiences were: using the skilled personnel and technological advantages of national defense scientific research academies and institutes to develop military-civilian dual-use or military-civilian integrated products and enter the main battlefront of national economic construction, focusing on intermediate testing base area construction, doing research on production technology, raising commercialization levels of S&T achievements, using production line transfer arrangements to receive quick benefits from the recipient enterprises and increasing the economic value of the technological content and substantially increasing the incomes of research institutes. The development of these academies and institutes is a correct direction for the strategic transition to "guarantee the military and convert to civilian products, use civilian products to develop the military". However, because of differences in the structure of specializations in national defense scientific research academies and institutes and differences in market bearing capacity, achieving integration of military and civilian products and using civilian products to develop the military will not be easy. We must consider their characteristics and difficulties and provide them with special support in policies. Otherwise, a substantial number of national defense schedule academies and institutes will face considerable difficulties in development.

I. Current Difficulties and Problems in National Defense Scientific Research Academies and Institutes

1. Since reform and opening up, because of a neglect of ideological education work for a period of time and the influence of the ideology of "looking for money" in everything, people's concepts of national defense grew increasingly indifferent and the sense of honor of the military industry gradually vanished. This sort of ideological trend is extremely ill-matched with the current situation in China and foreign countries and extremely unfavorable for the development of national defense scientific research and stability in S&T staffs.

2. Most large national defense scientific research academies and institutes were organized in the 1950's and 1960's and they concentrated a considerable number of top-quality skilled personnel trained in New China as well as superior quality instruments and equipment. They made important contributions to strengthening national defense modernization and construction, protecting our national security, and increasing our national might and military might. In the past several years, however, expenditures on national defense scientific research, capital construction, and technical upgrading have been unable to provide the minimum required investments and there has also been a superficial emphasis on high results. Skilled personnel that appeared in the 1950's and equipment from the 1960's must complete high-tech scientific research tasks of the 1980's.

3. Academies and institutes have heavy burdens, there have been rapid increases each year in retiring personnel, prices have risen, and there have been substantial increases in outlays for wages, welfare, and so on. However, funds for national defense scientific research activities have been allocated according to the base figure set several years ago (about 1,300 yuan/person). On this foundation, they had to reduce institutional funding, which is wholly inadequate to meet the basic wages of employees. National defense scientific research academies and institutes are now in a situation of "fighting to exist" and "trying to find rice for the pot". A situation of "abandoning the military and shifting to civilian products" can be found in several national defense scientific research units.

4. National defense scientific research tasks involve high requirements, great difficulty, long schedules, many tests and limited output, and low income (initial estimates show a profit rate of less than 3 percent). Moreover, a policy of non-compensated transfer is still in effect for national defense S&T achievements, which has made self-improvement and development more difficult. The hardships are even greater for academies and institutes on the third line. If this continues for long, it will be very hard to guarantee that key national defense scientific research forces do not become scattered and disorderly and to guarantee normal operation of national defense scientific research. By being forced into "abandoning military products and shifting to civilian products, using

civilian products to exist", "guaranteeing military needs" has become a task that demands immediate attention.

II. Policy Proposals

A. Reinforce comprehensive coordination, strengthen plan management

Since the 1960's, there have been frequent changes in the national defense scientific research system. In the electronics industry, for example, seven readjustments of the leadership system have occurred and with each readjustment handling matters has become more difficult, even to the extent of a situation of "no one in charge". This is particularly true for enterprises that have been transferred to lower levels, which has led to the disintegration of systems that integrated scientific research with production. Moreover, these readjustments were simply changes in the jurisdictional relationships of basic-level units and played no role whatsoever in promoting national defense scientific research. Research institutes and enterprises are in an awkward situation of emerging and perishing of themselves and are unable to form technical economic strengths. We propose overcoming the current state of decentralized management of our national defense scientific research by adopting appropriately centralized leadership and reinforcing directive-type plan management of national defense scientific research. At the same time, we hope that the number of levels will be reduced as much as possible to correct the current situation of the paring away of national defense scientific research expenditures at every level and ensure that our limited national defense funds are truly used for scientific research, renewal, and upgrading to improve the advanced measures of national defense scientific research.

B. Increase the intensity of national defense scientific research investments, accelerate implementation of technical upgrading plans for the conversion from military to civilian products

Based on the characteristics of national defense scientific research development of requiring high capital inputs and high knowledge inputs, the state should centralize sufficient capital to provide focused support for national defense scientific research and accelerate the implementation of improvements in scientific research measures and technical upgrading plans for the conversion from military to civilian products in national defense scientific research academies and institutes. We propose that investment proportions for scientific research and capital construction be coordinated, that the allocation system for capital construction and technical upgrading for national defense scientific research be restored, and that readjustments be made in their investment channels. Only in this way can national defense scientific research achieve sustained, stable, and coordinated development, walk out of the valley, and track advanced world levels.

C. Policy measures for "guaranteeing the military and converting to civilian products, using civilian products to develop the military"

To achieve the strategic transition of "integrating military and civilian products, integrating peacetime and war, giving preference to military products, and using civilian products to develop the military", strengthen our capability of shifting from peacetime to war, and protect key national defense scientific research forces from becoming scattered and disorderly, we offer these concrete proposals:

1. In taxation policies, besides national defense scientific research academies and institutes enjoying special policies stipulated by the State Science and Technology Commission and local finance and taxation departments, policy guidance and full tax exemption polices should also be implemented for military-civilian dual-use products or integrated military-civilian products for the conversion from military to civilian products developed by research institutes to strengthen the capabilities of national defense scientific research academies and institutes to make a transition from peacetime to war.

2. To compensate for insufficient state investments in capital construction and technical upgrading, we propose the adoption of accelerated fixed assets depreciation measures for national defense scientific research units to accumulate special technical upgrading funds for special accounts and special purposes.

3. Because of differences in the specialization and product structures of national defense scientific research units, to achieve "using military products to develop the military" and develop civilian products that are not integrated military-civilian ones, besides enjoying the relevant local policies, we propose that the tax exemptions be extended for 2 years.

4. Implement new measures for compensated transfer of military product achievements to readjust the income allocation relationships of scientific research and production units to fill in the low incomes of national defense scientific research tasks and even make up for losses. At the same time, we should raise the 5 percent profit rate limit on military products to motivate initiative to take on national defense scientific research.

5. The skilled personnel and equipment in national defense scientific research academies and institutes are relatively superior in quality, so they have advantages in developing high- and new-tech industry. While encouraging national defense scientific research academies and institutes to enter high- and new-tech development zones, we should also make a major effort to support national defense scientific research units in fostering their technological advantages and develop local high- and new-tech industry. After examination and ratification by the State Science and Technology Commission, allow them to enjoy special policies for parks and zones to accelerate the pace of "using civilian products to

develop the military" in national defense scientific research academies and institutes.

6. In addition to converting from military to civilian products, we should also relax policies regarding conversion from domestic to export products. Under unified control by the state, encourage exports and allow national defense scientific research units to use 50 percent of their own capital to undertake international cooperation and development.

7. To enable national defense scientific research academies and institutes to better serve the primary battlefields of national economic construction and promote the strategic shift from military to civilian products, we hope that relevant departments of the state will include conversion from military to civilian products in the state's civilian plans, treat them the same as civilian scientific research units, and include them in the state's civilian "Attacks on Key S&T Problems", "Torch", "Extension", and "863" plans for unified programs and unified arrangements.

8. Given the insufficient state investments in projects for conversion from military to civilian products and the limited capital held by national defense scientific research units themselves, state banks should implement low-interest or interest deduction loans to support the development of products for conversion from military to civilian products. Establish development funds for conversion from military to civilian products and support national defense scientific research in strengthening its self-improvement and development capabilities.

D. Policy proposals to safeguard national defense S&T staffs

To support a crack national defense scientific research staff, make national defense scientific research more attractive, and achieve the objective of "small scales, high levels", on a foundation of examining and accepting the proportion of military and civilian research in national defense scientific research units, the treatment of personnel involved in national defense scientific research in areas like welfare, bonuses, housing, and so on should be no lower than similar categories of personnel in other posts. In managing and evaluating national defense scientific research personnel, it would not be appropriate to mechanically adopt contractual responsibility systems centered on economic benefits. We should provide opportunities for renewal of knowledge, focus on education in outlooks on life and concepts of value, advocate the spirit of dedication, and protect and create a crack national defense S&T staff.

In summary, because national defense scientific research academies and institutes do not have sufficient military industry tasks during peacetime, we must implement a strategic transition and reduce state outlays on military expenditures. For this reason, national defense scientific research academies and institutes are already in a complex environment, so we hope that the State Planning Commission, State Science and Technology Commission, and National Defense Science, Technology, and Industry Commission will create an excellent external environment for national defense scientific research academies and institutes, adopt special "accommodation" measures, promote the rapid achievement of the objectives of "integrating military and civilian products, integrating peacetime and war, giving preference to military products, using civilian products to develop the military" in national defense scientific research units, strengthen their capabilities for making a transition from peacetime to war, strengthen their abilities to "use civilian products to develop the military" and achieve self-improvement, self-upgrading, and self-development, and make even greater contributions to the main battlefields in national defense modernization and national economic construction.

(Draft provided by Zheng Zhenxing [6774 2182 5281])

Survey Reports on Reform of R&D Institutions

92FE0215A Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] in Chinese No 6, Nov 91 pp 1-11

[Article by Xu Yongchang [1776 3057 2490], Yang Qiquan [2799 6386 0356], Wang Yujue [3769 3022 3778], Tan Guolin [6223 2654 2651], and Chen Mingping [7115 2494 1627] of the 'National Research and Development Organization Science and Technology System Reform Situation Sample Survey' Topical Group: "Analytical Report on the Reform Situation in Research and Development Organizations"]

[Text] Abstract: This reported analyzed the large amount of data obtained in a sample survey to make a relatively accurate description of the basic situation of R&D organization management and reform in China, for example, by making an on-the-spot analysis and evaluation of reform of the S&T system by academy and institute directors and S&T personnel on the front line of S&T system reform and objectively describing trends and developments in S&T system reform in China's R&D organizations.

Since the promulgation of the "CPC Central Committee Decision Concerning Reform of the S&T System" in 1985, S&T system reform as a component of overall reform has unfolded comprehensively on a national scale. The success or failure of reform will determine the future of China's S&T activities and affect the development of every aspect of China's society and economy. To give an accurate reflection of trends and developments in S&T system reform and provide bases and proposals for macro decision making concerning intensive reform, the "National Research and Development Organization Science and Technology System Reform Situation Sample Survey" Topical Group conducted a sample survey of the S&T system reform situation in scientific research organizations throughout China in July 1990. The scope

of this sample survey covered independent R&D organizations under ownership by the whole people in the natural science and technology realm at the county level and above. The content of the survey concerned personnel, expenditures, S&T activities, S&T achievements, orientation toward society, orientation toward the economy, and other management and reform conditions.

This sample survey sent out over 600 copies of the "Scientific Research and Technology Development Organization S&T System Reform Sample Survey Form" (abbreviated below as the "Sample Survey Form") and 10,000 copies of the "S&T System Reform Situation Sample Survey Questionnaire" (abbreviated below as the "Sample Questionnaire"). We also sent the "Survey Questionnaire on the Situation in Reform of the S&T System" (abbreviated below as the "Academy and Institute Director Questionnaire") to academy and institute directors in R&D organizations under the jurisdiction of departments of the State Council and local provinces. We received back 589 copies of the "Sample Survey Form", 6,468 copies of the "Sample Questionnaire", and 1,000 copies of the "Academy and Institute Director Questionnaire". The sample data collected from the "Sample Survey Questionnaire" and the results of statistical error calculations indicate that the error for all major indicators was within acceptable limits and that the overall reliability and accuracy of the data was rather satisfactory. We will now report the relevant data from this survey and the analytical report.

I. Profound Changes Have Occurred in R&D Organizations

A. A change in direction has occurred in R&D organizations

Since the implementation of reform, R&D organizations and in particular technology development-type research institutes have used various forms to serve society and the economy and have begun to make a transition from the past purely closed state scientific research type to a scientific research administration type. This change of direction in scientific research organizations can be confirmed by the renewal of people's consciousness and concepts and by changes in the tasks, expenditures, achievements, and so on in scientific research organizations.

1. The consciousness of orientation has been strengthened. Under guidance by the principle of "orienting [toward the economy and society], relying [on S&T progress]" and propulsion by the policy of reform and opening up, many management personnel and S&T personnel in R&D organizations have changed their traditional concepts of the past and dedicated themselves with a high degree of enthusiasm to reform practice and taking the initiative in orienting toward society, orienting toward the economy, and using their own intelligence and skills to promote S&T progress in society and develop the cause of S&T. In the "Academy and Institute Director Questionnaire", 95.5 percent of the academy and institute directors felt that reform of the S&T system has strengthened consciousness of orienting toward society and orienting toward the economy in scientific research organizations. The renewal of people's consciousness and concepts is the decisive condition for changing tracks and types in scientific research organizations and an important ideological foundation for carrying out reform of the S&T system.

2. The operational mechanisms of "task assignment by the state, funds allocated by the state, achievements taken care of by the state" have changed. Before reform, the state took unified care of everything for R&D organizations including tasks, funds, achievements, and so on. This single model seriously impeded the integration of scientific research organizations with society and the economy for a long time. Reform of the S&T system has reformed allocation patterns to implement a series of reform measures like commercialization of technical achievements, opening up technology markets, and so on and established in an initial form new operational mechanisms, promoted the integration of S&T with the economy, and spurred a change in direction in R&D organizations.

From January to June 1990, China's R&D organizations assumed responsibility for 116,900 scientific research topics (including new topics for 1990 and topics carried over from 1989). Table 1 shows the number of projects and fund inputs for topics that were assigned by higher authorities, topics commissioned horizontally, and self-established topics.

Table 1. Distribution of Scientific Research Topics According to Source (Percent)

Item	Topics assigned by higher authorities	Topics commissioned horizontally	Self-established topics
Percentage of total number of topics	55.3	25.4	19.3
Percentage of total expenditures on topics	64.2	27.5	8.3

Data from the 1985 National Science and Technology Survey show that the number of horizontally commissioned topics and expenditures on them accounted for 16.3 percent and 15.9 percent, respectively, of the total number of topics and total topic expenditures in R&D organizations under the jurisdiction of departments of the People's Government throughout China. The number of topics commissioned by enterprises and topic funds inputs accounted for 68.7 percent and 67.8 percent, respectively, of horizontally commissioned topics during the first half of 1990. The number of topics and topic fund inputs commissioned by large and medium-sized enterprises throughout China accounted for 62.7 percent and 82.8 percent, respectively, of the topics commissioned by enterprises. The data collected on S&T statistical data show that from 1986 to 1989,

government allocations as a proportion of R&D organization fund income were 64.4 percent, 59.1 percent, 50.2 percent, and 45.6 percent each year, a reduction of 18.8 percent over 4 years. During the first half of 1992, China's R&D organizations transferred a total of 32,000 S&T achievements. Table 2 lists them according to the category of recipient.

Table 2. Transferred Achievements Listed According to Category of Recipient (Percent)

Category of recipient	Large and medium-sized enterprises under ownership by the whole people	Small enterprises under ownership by the whole people	Collectives and township and town enterprises	Scientific research organizations	Institutions of higher education	Other
Percentage	37.9	24.1	27.2	3.4	0.9	6.5

The number of scientific research achievements from R&D organizations throughout China that passed appraisal was 19,600 in 1985 and 21,100 in 1989, while the number extended and applied was 16,100 in 1985 and 23,200 in 1989. The number of appraised achievements that were extended and applied increased by 44.1 percent from 1985 to 1989. In the "Academy and Institute Director Questionnaire", after comparing and analyzing conversion rates for all categories of achievements from 1988 to 1989, the academy and institute directors provided the estimates and views listed in Table 3.

Table 3. Academy and Institute Directors' Estimates of Changes in Conversion Rates for All Categories of Achievements (Percent)

Item	Increased	Held steady	Decreased	No estimate made
Conversion rate for all achievements	59.1	19.6	7.2	14.1
Conversion rate for vertical topic achievements	38.9	25.7	10.9	24.5
Conversion rate for horizontal topic achievements	50.0	20.0	4.5	25.5
Conversion rate for self-established topic achievements	32.6	22.8	6.9	37.7

In an overall environment of weak markets, the conversion rate for scientific research achievements still maintained a rather fast growth momentum, showing that S&T are playing an increasingly important role in social and economic realms and illustrating that reform has promoted close integration of S&T with the economy. The "Sample Questionnaire" provided a rather high assessment of the effectiveness of implementing the reform measure of opening up the technology market, with 75.5 percent feeling that it had good and regular implementation effectiveness and 82.7 percent feeling that it should continue being implemented. Of the 1,000 academy and institute directors, 83.5 percent felt that scientific research organizations had increased social and economic benefits in the process of orienting toward society and toward the economy. Comparative analysis of this series of data shows that there has been a preliminary reversal in the situation of "task assignment by the state, funds allocated by the state, achievements taken care of by the state" in China's R&D organizations. Obvious achievements have been made in integrating S&T with the economy.

B. R&D organizations have greater vitality

Invigoration of scientific research organizations and invigoration of S&T personnel management policies have created profound changes in the leadership systems and internal management of R&D organizations, which has in turn increased the vitality of scientific research organizations and further promoted the initiative and creativity of large numbers of S&T personnel.

1. The decision-making rights of scientific research organizations have been expanded. Promulgation and implementation of the "CPC Central Committee Decision Concerning Reform of the S&T System" and the "Provisional Stipulations of the State Council Concerning Expansion of the Decision-Making Rights of Scientific and Technical Research Organizations" expanded the decision-making rights of scientific research organizations. Most scientific research organizations have established their status as legal persons and research academies are serving as relatively independent R&D entities oriented toward society and toward the economy, which has increased the effectiveness, efficiency, and results of scientific research organizations. As a result, they have been welcomed by many S&T personnel. In the "Sample Questionnaire", the evaluations of all categories of S&T personnel concerning expansion of the decision-making rights of organizations are given in Table 4. Among them, 6.1 percent of the people did not express an opinion concerning the results of implementation and 12.4 percent did not state whether or not they should be continued. In comparison, the view that "expanding the decision-making rights of scientific research organizations" should be continued and perfected accounted for the highest proportion.

Table 4. Assessment of the Expansion of Decision-Making Rights of Scientific Research Organizations

	Results of implementation			Continue to persist or not	
	Good	Usual	Poor	Continue to persist and perfect	Cease implementation
Percentage	33.5 percent	48.7 percent	11.7 percent	86.2 percent	1.4 percent

2. New leadership systems and management systems have been implemented. Along with expanding the decision-making rights of scientific research organizations, they have also gradually implemented a director responsibility system, contractual administrative responsibility system, and other new leadership systems and management systems. In the "Academy and Institute Director Questionnaire", 76.0 percent of the R&D organizations under the jurisdiction of State Council departments and provinces had implemented an institute director responsibility system while 11.5 percent had implemented a contractual administrative responsibility system. The proportions of academy and institute directors who felt that implementation of an institute director responsibility system and contractual administrative responsibility system in scientific research organizations was appropriate were 80.9 percent and 27.1 percent, respectively, while those who felt it was "inappropriate" accounted for 4.4 percent and 30.5 percent, respectively. Table 5 lists the assessments from the "Sample Questionnaire" of the implementation results from "implementing an institute director responsibility system" and "implementing a contractual administrative responsibility system".

Table 5. Evaluations of Implementation of New Leadership Systems (Percent)

Implementation results	Good	Usual	Poor	No evaluation
Implementation of institute director responsibility system	34.7	49.9	8.2	7.2
Implementation of institute director term of office objective responsibility system	31.6	46.0	14.7	7.7

Table 5 shows that nearly one-half of the number of people felt that the implementation results of new leadership systems have been usual while about one-third considered the results to be good. The implementation results for the institute director responsibility system were somewhat better in comparison. There were 80 percent of the people who felt that the new leadership systems should be continued to be implemented and perfected.

Table 6 lists assessments of the implementation results of the contractual administrative responsibility system as a new type of management system by S&T personnel in different categories of scientific research organizations. The social public welfare category in Table 6 refers to social public welfare institutions, technical foundations, and agricultural scientific research category units. The other categories refer to units that have not implemented institutional funds classification management. The assessments and opinions given in Table 6 are relatively dispersed, but the implementation results of the contractual administrative responsibility system in different categories of R&D units were all rather poor.

Table 6. Evaluations Concerning Implementation of the Contractual Administrative Responsibility System (Percent)

Implementation results	Good	Usual	Poor	No evaluation
Technology development category	18.1	41.6	29.0	11.3
Basic research category	14.0	35.7	30.0	20.3
Social public welfare category	14.4	37.2	31.5	16.9
Multiple categories	15.9	42.3	26.9	14.9
Other categories	14.7	35.5	31.5	18.3

The situation above shows that a common feeling in scientific research organizations is that the "institute director responsibility system" and "institute director term of office objective responsibility system" are "appropriate" leadership systems for scientific research organizations, that the implementation results are also rather good, and that most people feel that they should continue persisting and perfect it. More extensive probing is required into the reasons for the rather substantial divergence of opinions concerning implementation of contractual administrative responsibility systems in scientific research organizations.

3. The "two invigorations" policy [invigoration of scientific research organizations and invigoration of S&T personnel management policies] has effectively promoted reform of planning, funding, personnel, assignment, and so on in the management system, organizational structure, and other aspects in R&D

organizations. Contractual responsibility systems, economic accounting systems, technology contract systems, appointment systems, and several other new management systems have been widely implemented in scientific research organizations and they have really activated the operational mechanisms of research institutes.

Table 7 shows the situation concerning the implementation of contractual responsibility at every level, partial contractual responsibility, and no implementation of contractual responsibility in the 1,000 research institutes under the jurisdiction of ministries and provinces (there were 31 institutes that did not fill in their situation regarding implementation of contractual responsibility).

Table 7. Situation in Implementating Contractual Responsibility in Scientific Research Organizations (Percent)

	Implemented contractual responsibility at every level	Partial contractual responsibility	No implementation of contractual responsibility above or below
Percentage of the 1,000 organizations	18.7	61.6	16.5

Tables 8 and 9 reflect the assessments and views of management personnel and scientific research personnel regarding the implementation results of management system reform measures in scientific research organizations and whether or not they should continue to persist and perfect.

Comparative analysis of Tables 8 and 9 shows that the evaluations and views of the "specialized technical job title appointment system" were about the same while there were rather substantial differences for the other evaluations and views, with the assessments of scientific research personnel being somewhat better. Overall, however, many problems exist in all of these management system reform measures.

Table 8. Evaluations of Management System Reform Measures By Management Personnel (Percent)

Reform measure	Implementation results				Continue to persist or not		
	Good	Usual	Poor	No assessment given	Continue to persist and perfect	Cease implementation	No answer
Specialized technical job title appointment system	22.6	54.7	18.6	4.1	83.0	4.9	12.1
Encouraging personnel circulation	15.7	37.4	41.4	5.5	76.5	8.7	14.8
Allowing second jobs	7.4	23.9	60.2	8.5	42.8	41.9	15.3
Implementing optimized combinations	12.4	35.4	44.5	7.7	64.8	19.1	16.1
Implementing contractual responsibility for topics	21.9	47.5	23.6	7.0	71.0	14.3	14.7

Table 9. Evaluations of Management System Reform Measures By Scientific Research Personnel (Percent)

Reform measure	Implementation results				Continue to persist or not		
	Good	Usual	Poor	No assessment given	Continue to persist and perfect	Cease implementation	No answer
Specialized technical job title appointment system	25.3	51.7	18.0	5.0	82.4	4.6	13.0
Encouraging personnel circulation	22.3	32.9	38.0	6.8	81.7	3.9	14.4
Allowing second jobs	14.1	28.8	47.3	9.8	63.2	20.0	16.8
Implementing optimized combinations	20.0	34.3	36.8	8.9	73.0	10.3	16.7
Implementing contractual responsibility for topics	26.2	42.3	23.9	7.6	75.7	9.7	14.6

C. R&D organizations have become somewhat stronger

Analysis of data from survey indicates that in addition to orienting toward society and orienting toward the economy, scientific research organizations have also become stronger.

1. Some increases in scientific research tasks, some raising of levels. During the first half of 1990, the total

number of scientific research topics taken on by R&D organizations throughout China was 116,900, an increase of 22.4 percent over the total number of topics they accepted in 1986. Table 10 shows evaluations of the scientific research tasks taken on by R&D organizations before and after reform and changes in topic difficulty and depth in the "Sample Questionnaire". The evaluation opinions in Table 10 are rather scattered, but the differences between increases and reductions and between improvements and reductions are not too great. Overall, however, there has been a trend of increases in scientific research tasks and improvements in scientific research levels in R&D organizations since reform.

Table 10. Evaluation of Changes in Scientific Research Tasks and Levels (Percent)

Item	Increase or improvement	Some increase or improvement	Held steady	Some reduction	Reduction	No evaluation made
Scientific research tasks	21.0	20.1	19.3	18.8	15.9	4.9
Topic difficulty and depth	18.5	23.6	20.9	16.8	14.7	5.5

Tables 11 and 12 compare evaluations and views of academy and institute directors of changes in scientific research tasks and scientific research levels in 1988 and 1989.

Table 11. Evaluation by Academy and Institute Directors of Changes in Scientific Research Tasks (Percent)

Item	Increase	Held steady	Reduction	No evaluation made
Total number of scientific research topics	53.9	20.0	23.2	2.9
Number of vertical topics	31.3	24.7	33.8	10.2
Number of horizontal topics	50.5	21.0	14.6	13.9
Number of self-established topics	36.8	20.1	22.5	20.6

Table 12. Evaluation by Academy and Institute Directors of Changes in Scientific Research Levels (Percent)

Item	Improvement	Held steady	Reduction	No evaluation made
Overall scientific research levels	49.3	26.1	15.7	8.9
Level of vertical topics	41.0	25.5	15.9	17.6
Level of horizontal topics	38.2	31.2	8.3	22.3
Level of self-established topics	29.7	26.6	11.4	32.3

In Table 11, the proportion which felt that there had been a reduction in vertical topic tasks was greater than the proportion for an increase, the proportion stating an increase in horizontal tasks was greater, and there was some increase in self-establish topic tasks. The evaluations and views of academy and institute directors in Table 12 show a substantial improvement in scientific research levels.

Quantitative comparative analysis and analysis of the evaluations in the different questionnaires show that the overall trend is some increase in scientific research tasks and some improvement in scientific research levels in R&D organizations since prior to reform.

The problem of insufficient scientific research tasks is still acute, however. There were 74.6 percent of the people in the "Sample Questionnaire" who felt that "scientific research tasks are insufficient", while 74.4 percent of the academy and institute directors felt that "insufficient tasks and overstaffing" are one of the main factors restricting S&T personnel in fostering their roles.

2. Rather rapid increases in portions of fixed assets raised by themselves. Since 1985, there has been a rather substantial increase in the proportion of fixed assets (including fixed assets used in scientific research and production) raised by R&D organizations throughout China. In 1985, the portion raised by themselves accounted for 9.6 percent of the original value of total fixed assets. By June 1990, the portion raised themselves accounted for 12.7 percent of the original value of total fixed assets. Among the original value of newly-added fixed assets from January to June 1990, the portion they raised themselves accounted for 18.5 percent. On 30 June 1990, all of China's R&D organizations had 146,500 pieces (sets) of instruments and equipment over 50,000 yuan in value, of which they had purchased 18,300 pieces (sets) or 12.5 percent from their own funds. This included 96,600 pieces (sets) of instruments and equipment produced during and after the 1980's, of which they purchased 17,300 pieces (sets) or 17.9 percent from their own funds. The growth in the self-raised portion as a part of the increase in fixed assets in R&D

organizations is far higher than the growth from the portion from state investments, which shows that the state's investments in fixed assets in scientific research organizations are far from capable of meeting the needs of scientific research development.

3. Some strengthening of scientific research staffs; young staffs are now growing up. According to S&T statistical data, the number of scientists and engineers in China's R&D organizations increased by 23.68 percent from 1986 to 1989. Scientists and engineers as a proportion of the total number of employees was 31.83 percent in 1986 and 39.96 percent in 1989. Topic personnel accounted for 30.6 percent of the total number of employees in R&D organizations in 1986 and 39.5 percent in 1990, an increase of 8.9 percent. Since 1978, there have been 23,300 personnel from R&D organizations who have gone to study in foreign countries and 13,400 of them have returned to China. Among them, 80.7 percent are involved in topic activities. Among the more than 5,000 renowned specialists in R&D organizations in 1990, 82.8 percent were engaged in topic work. In the "Academy and Institute Director Questionnaire", 43.6 percent of the respondents felt that scientific research forces had been strengthened while 36.1 percent expressed a negative view. In summary, there have been significant increases in the number of scientists and engineers in R&D organizations and in the number of personnel who returned to China after completing their studies and being involved in scientific research work in the past several years. Overall, scientific research forces have certainly been strengthened. This is an extremely important factor behind the strengthening of scientific research organizations and the development of scientific activities.

Table 13 shows the age cohort distribution situation for personnel involved in topic activities in China's research organizations in 1990 based on the data collected in the "Sample Survey Form". The average age of personnel in topic activities was 38.9 years, slightly lower than the average age of 39.9 years for specialized technical personnel in China engaged in scientific research.

Table 13. Age Cohort Distribution for Topic Activity Personnel (Percent)

Age cohort	34 years and under	35 to 44 years	45 to 54 years	55 years and over
Percentage	42.0	18.4	32.1	7.5

Table 13 shows that among S&T personnel on the front line, 42.0 percent are 34 years and under (29.5 percent are 29 and under, 12.5 percent are 30 to 34), which exceeds the proportion of S&T personnel 45 years and older. This group of young S&T personnel who had not yet entered scientific research staffs 10 years ago will become the main force in China's S&T staff at the end of this century and the start of the next one, so the maturation and growth of our young S&T staff undoubtedly will spur the development of China's S&T activities.

II. We Must Persist With Reform

After several years of practice in reform, how can reform of the S&T system be evaluated? What effects has reform had on scientific research organizations? What is the situation in implementation of reform measures? Below we provide the views of 1,000 academy and institute directors and 6,468 management personnel and scientific research personnel in R&D organizations.

1. When answering the question "Are you satisfied with work to reform the S&T system over the past 5 years", among the 6,468 people, 5.1 percent felt "satisfied", 66.9 percent felt "basically satisfied", and 24.0 percent felt "dissatisfied". Table 14 shows the views regarding reform of the S&T system of all categories of personnel in different types of scientific research organizations. Table 15 shows the views regarding reform of the S&T system of management personnel, scientific research personnel, S&T personnel with high-level specialized technical duties, and topic group leaders in scientific research organizations. Table 16 shows the views of people of different ages regarding reform of the S&T system.

Table 14. Views of All Categories of Personnel in Different Types of Organizations Regarding System Reform (Percent)

Category of organization	Satisfied	Basically satisfied	Dissatisfied	No opinion
Technology development type	5.3	67.4	23.0	4.3
Basic research type	4.5	65.9	24.8	4.8
Social public welfare type	6.2	70.4	20.6	2.8
Multiple type	4.6	65.9	25.2	4.3
Other types	3.7	67.6	24.5	4.2

Table 15. Views of All Categories of S&T Personnel Concerning Reform of the S&T System (Percent)

Category	Satisfied	Basically satisfied	Dissatisfied	No opinion
Scientific research management personnel	4.7	72.7	19.0	3.6
Scientific research personnel	5.3	64.3	26.0	4.4
High-level job title personnel	4.4	66.8	23.9	4.9
Topic group leaders	5.2	66.8	23.9	4.1

Table 16. Views of People of Different Ages Concerning Reform of the S&T System (Percent)

Age group	Satisfied	Basically satisfied	Dissatisfied	No opinion
34 years and under	5.3	62.2	30.1	2.4
35 to 44 years	5.4	72.9	18.4	3.3
45 to 54 years	4.6	67.3	23.4	4.7
55 years and over	5.9	66.5	22.4	5.2

2. The 1,000 academy and institute directors evaluated the effects of reform of the S&T system on scientific research organizations in several areas (Table 17).

Table 17. Evaluation of the Effects of System Reform on Scientific Research Organizations (Percent)

Item	Affirm	Deny	Not clear	No evaluation
Strengthened consciousness of orienting toward society and the economy	95.5	0.9	2.0	1.6
Raised S&T levels	35.8	28.4	31.1	4.7
Strengthened S&T reserves	18.1	45.5	30.5	5.9
Aided S&T staff construction	30.2	26.8	37.6	5.4
Increased social and economic benefits	83.5	1.7	12.7	2.1

3. Table 18 shows the opinions of all categories of S&T personnel in the "Sample Questionnaire" concerning whether they should continue to persist with and perfect reform measures or cease implementation.

Table 18. Views of All Categories of S&T Personnel Regarding Whether or Not To Persist With Reform Measures (Percent)

Reform measure	Persist and perfect	Cease implementation	No opinion given
Reform of the allocation system	67.3	17.9	14.8
Expand decision-making rights of research organizations	86.2	1.4	12.4
Open up technology markets	82.7	1.9	15.4
Have scientific research organizations use various means to enter the economy	66.8	9.3	23.9
Integration of technology, industry (agriculture), and trade	55.2	15.5	29.3
Implement institute director responsibility system	80.1	4.8	15.1
Implement institute director term of office objective responsibility system	80.5	4.7	14.8
Implement contractual administrative responsibility system	59.8	19.0	21.2
Specialized technical duty appointment system	82.4	4.9	12.7
Encourage personnel circulation	79.7	5.6	14.7
Permit second jobs	56.3	27.7	16.0
Implement optimized combinations	69.9	13.6	16.5
Implement topic contractual responsibility	74.0	11.1	14.9

4. The view of academy and institute directors regarding "whether or not reform of the S&T system is synchronized with reform of the political and economic systems" was that 38.1 percent felt that "reform of the S&T system is leading", 48.5 percent felt that they were "basically synchronized", and 12.5 percent felt that "reform of the S&T system is lagging behind". Collection of data from the groups mentioned above and analysis shows that:

a. Some 72 percent of all categories of personnel in R&D organizations are satisfied and basically satisfied with work to reform the S&T system over the past several years. This is an objective assessment and full affirmation of work to reform the S&T system as well as an important prerequisite for intensive reform. That reform must persist is a conclusion that conforms to laws and the will of the people.

b. The original intention in reform of the S&T system was mainly to solve the long-term problem of the detachment of S&T from the economy. Practice in reform over several years has improved people's understanding and significant achievements have been made. Some 95.5 percent of the academy and institute directors felt that it had strengthened consciousness of orienting toward society and orienting toward the economy and 83.5 percent felt that it had increased social and economic benefits.

c. There was substantial disagreement regarding analysis and evaluation views of the implementation situation for several reform measures. The implementation results of some reform measures were rather good, for example, expanding the decision-making rights of scientific research organizations, opening up technology markets, implementing an institute director responsibility system, and so on. The implementation results of some reform measures were rather poor, for example, permitting second jobs, integration of technology, industry (agriculture), and trade, implementing optimized combinations, and so on. While there were both good and bad implementation results, most people felt that we should persist with and perfect these reform measures.

d. Many problems and difficulties exist at present in scientific research organizations, the most prominent ones being low inputs, inadequate reserve strengths, not fostering the role of S&T personnel well, and so on, and it has caused some people to have misgivings about reform. Some 24 percent of the people were dissatisfied with work to reform the S&T system and 45.5 percent of the academy and institute directors expressed negative opinions regarding "whether or not S&T reserve strengths have been reinforced". To be sure, several of these problems and difficulties are not the inevitable result of S&T system reform but they truly have created rather substantial effects and difficulties for S&T system reform. They should receive a high degree of attention in intensive reform of the S&T system, conscientiously studied, and dealt with comprehensively.

e. System reform involves complex systems engineering. Reform of the S&T system should be coordinated with and mutually supplement reform of the political, economic, and other systems. Some 48.5 percent of the academy and institute directors felt that reform of the S&T system was basically synchronized with reform of the political and economic systems, but 50.6 percent of them felt that S&T system reform was leading ahead or lagging behind. A situation of reforms that are not too synchronized creates many restricting factors that make the results of reform and the implementation situation of many reforms less than ideal. Thus, intensive reform of the S&T system depends on improvement of the larger social environment and on unified coordination of reform of the political system, reform of the economic system, and so on.

III. Some Questions That Should Receive Attention

A. Funding shortages

For a variety of reasons, R&D organizations have experienced funding shortages during the past 5-plus years of reform and investments in scientific research work have been too low. Some 91.5 percent of the academy and institute directors felt that insufficient scientific research funds had become a major factor restricting the roles of S&T personnel. After comparative analysis of scientific research funds and topic funds in 1988 and 1989, Table 19 lists the evaluations and views of academy and institute directors. The assessments and views given in Table 19 show that with the exception of the feeling that there had been significant increases in horizontal topic funds, the overall view was that scientific research funds have been reduced.

Table 19. Evaluations By Academy and Institute Directors of Changes in Scientific Research Funds and Topic Funds (Percent)

Item	Increased	Held steady	Reduced	No evaluation
Total number of scientific research funds	32.9	20.3	44.0	2.8
Vertical topic funds	25.0	19.1	45.9	10.0
Horizontal topic funds	42.7	21.0	21.2	15.1
Self-established topic funds	28.5	20.4	29.0	22.1

Insufficient funds have created difficulties for R&D organizations and affected scientific research work and research institute development. Based on the "Survey Questionnaire", Table 20 analyzes whether or not the problem of insufficient funds exists and if it exists, how great is its impact on scientific research work and the

development of research institutes. Analysis of Table 20 shows that 94 percent felt that "research funds are inadequate", 92.1 percent felt that "institutional funds are inadequate", and 86.3 percent felt there was a "shortage of circulating funds". It is apparent that the problem of fund shortages is common in R&D organizations. The impact of inadequate funds on scientific research work and the development of research institutes is far more serious than the effects created by other problems.

Table 20. Analysis of the Effects of Insufficient Funds (Percent)

Item	Does not exist	Substantial effects	Rather substantial effects	Normal effects	Rather limited effects	No answer given
Insufficient research funds	3.8	48.7	36.0	7.8	1.5	2.2
Insufficient institutional funds	3.2	42.9	33.9	13.0	2.3	4.7
Shortage of circulating funds	4.5	30.8	33.8	17.6	4.1	9.2

Similar results were obtained from analyzing different categories of R&D organizations. Table 21 shows a comparative analysis of the effects of insufficient research funds on large academies and large institutes (referring to the 193 scientific research organizations with more than 400 scientists and engineers, with the same holding true below) and small institutes (referring to the 3,234 scientific research organizations with 49 and fewer scientists and engineers, with the same holding true below). Some 93.6 percent of S&T personnel of all categories in large academies and institutes felt that "research funds are insufficient" while 96 percent of S&T personnel of all categories in small institutes felt that "research funds are insufficient". Table 21 shows that the effects of insufficient research funds on scientific research work and the development of research institutes were somewhat greater in small institutes.

Table 21. Comparative Analysis of Insufficient Research Funds and the Effects (Percent)

Institution	Does not exist	Substantial effects	Rather substantial effects	Normal effects	Rather limited effects	No answer given
Large academies and institutes	4.3	45.8	37.6	8.8	1.4	2.2
Small institutes	3.0	55.5	33.7	5.9	0.9	0.9

B. Inadequate reserve strengths

1. Capital construction abilities are not equal to ambitions. Because of inputs that are too low and insufficient funds as well as the overly rapid growth of all types of outlays, the burdens on scientific research organizations are too heavy and most want to but are unable to invest in capital construction. The data collected in the "Sample Questionnaire" show that "aging instruments and equipment", "inability to deal with capital construction and technical upgrading", "insufficient technical reserves", "unavailability or absence of intermediate testing conditions", and other problems are common in scientific research organizations, as shown in Table 22. Table 23 analyzes the extent to which these problems or difficulties have affected the development of research institutes. "Aging instruments and equipment", "inability to deal with capital construction and technical upgrading", "unavailability or absence of intermediate testing conditions", and other problems are common in different categories of scientific research organizations, in large academies and institutes and in small institutes, and in scientific research organizations under the jurisdiction of the State Council and the jurisdiction of departments above the local and county level, and these problems have had rather substantial effects on scientific research work as well as the development of research institutes. These difficulties and problems are directly related to absent or sluggish funding source channels and funding shortages described above.

Table 22. Analysis of Whether or Not "Aging Instruments and Equipment" and Other Problems Exist (Percent)

Item	Does not exist	Exists	No analysis
Aging instruments and equipment	4.5	92.1	3.4
Inability to deal with capital construction and technical upgrading	5.2	87.9	6.9
Unavailability or absence of intermediate testing conditions	10.0	77.9	12.1

Table 23. Analysis of the Effects Created By "Aging Instruments and Equipment" and Other Problems (Percent)

Item	Substantial effects	Rather large effects	Usual effects	Rather small effects
Aging instrument and equipment	43.0	33.6	12.7	2.8
Inability to deal with capital construction and technical upgrading	40.2	30.3	13.8	3.6
Unavailability absence of intermediate testing conditions	22.5	30.0	19.8	5.6

2. Working conditions urgently await improvement. Improving working conditions undoubtedly is extremely important for strengthening scientific research organizations, raising scientific research levels, and promoting the development of S&T activities, but the tasks now for R&D organizations in improving scientific research working conditions are still very heavy. Some 50.3 percent of academy and institute directors felt that there had been no significant improvement in the working conditions in scientific research organizations, and 46.6 percent of the people in the "Sample Questionnaire" felt that scientific research working conditions had worsened.

3. Insufficient technical reserves. In the "Sample Questionnaire", 90.7 percent felt that scientific research organizations had "insufficient technical reserves". There were 22,600 self-established topics in R&D organizations in 1990, equal to 19.3 percent of the total number of topics in that year, but funding for self-established topics only accounted for 8.3 percent of total topic funds. Self-established topics in scientific research organizations mainly involve leading exploratory research, and reserve technology is an important indicator of research organizations' strengths and development reserves. The sample survey showed, however, that inputs in self-established topics are very low and that the average funding per topic was 17,000 yuan, just 37.1 percent of the average funds for vertical topics and 39.5 percent of the average funds for horizontally commissioned topics. The average schedule for self-established topics has been shortened by one-half year compared to 1985. This shows that self-established topics have now become an important way for technology in scientific research organizations to generate income, so they no longer are characterized by mainly having to reflect development reserve strengths. Regarding the question of whether scientific research organization "S&T reserve strengths been strengthened or not", 45.5 percent of the academy and institute directors held negative opinions while only 18.1 percent held affirmative views.

C. The role of S&T personnel is far from being fully fostered

Many problems like irrational structures, unstable staffs, personnel faults [duan ceng 2451 1461—geological fault], and so on exist to varying degrees in S&T staff construction in R&D organizations, but the most acute problem in comparison is that the role of S&T has not been fostered as it should. In the "Academy and Institute Director Questionnaire", 37.3 percent felt that "S&T personnel basically play their role" while 33.3 percent felt that "one-fifth are not playing their role", 24.0 percent felt that "one-third are not playing their role", and 4.9 percent felt that "one-half are not playing their role". The academy and institute directors felt that the problems listed in the table below are the main factors that restrict S&T personnel in playing their roles.

Table 24. Analysis By Academy and Institute Directors of Factors Restricting S&T Personnel In Playing Their Role (Percent)

Restricting factor	Percentage of 1,000 academy and institute directors
Insufficient tasks, overstaffing	74.4
Irrational structures, poorly matched forces	74.8
Difficult for personnel to circulate, difficult to make arrangements for excess personnel after optimized combination	78.0
Insufficient scientific research funds, difficulty in undertaking self-establish topics	91.5
Spiritual and material factors that have increased centrifugal forces	69.1
Too-large a proportion of low-level horizontal topics	59.2
Excessive non-research work burdens for S&T personnel	62.5

One important problem that must be solved in reform of the S&T system is fully fostering the initiative of S&T personnel, but this problem has still not been resolved. Table 24 shows that increased investments and intensive reform of the personnel system are the keys to solving this contradiction at the present time.

Note: This topic was commissioned by the State Science and Technology Commission Comprehensive Planning Department and was organized and implemented by the State Science and Technology Commission S&T System and Management Institute.

Technical Progress, Deepening Enterprise Reform Discussed

92FE0276A Taiyuan JISHU JINGJI YU GUANLI YANJIU [TECHNOECONOMICS & MANAGEMENT RESEARCH] in Chinese No 6, Dec 91 pp 3-6

[Article by Chen Wenhui [7115 2429 6540] and Han Jian [7281 0313]: "Technical Progress and Intensive Enterprise Reform"]

[Text] Technical progress plays an important role in promoting economic development. The manifestation of this promoting role becomes increasingly apparent as the economy of each country develops. In the modern age, technical progress has already become the dominant force in economic growth in many economically developed nations. It is precisely because of the promoting role that technical progress plays in economic development that many countries, especially several developed nations, have paid special attention to promoting technical progress, invested large amounts of manpower and materials in S&T development, and achieved significant results.

I. China Lags Substantially Behind the Developed Countries of the World in the Area of Technology

There have now been substantial improvements in technology levels in China. Compared with the developed nations, however, China's technical levels are still very backward and we lag substantially behind.

1. Technical levels of equipment. According to a 1985 industrial survey, technoeconomic functions attaining regular levels of similar international equipment of the late 1970's and early 1980's in the more than 19,000 key industrial enterprises surveyed accounted for just 12.9 percent, those attaining advanced levels within China accounted for 21.8 percent, for a total of 34.7 percent, while 47 percent were at regular levels within China and 18.3 percent were at backward levels, for a total of 65.8 percent.

2. Industrial automation, mechanization, and extent of powered equipment. At the end of 1985, there were 20.626 million direct production workers in basic production workshops in China's 134,000 independent accounting industrial enterprises at the county level and above. Of them, only 1.4 percent were involved in automated and semi-automated control operations, 20.1 percent were involved in mechanized operations, 37.6 percent of the workers were involved in semi-mechanized operations, and 40.9 percent were involved in manual operations. At the end of 1985, all of China's independent accounting industrial enterprises had 8,299 numerical control machine tools and 4,947 simple numerical control machine tools, equal to 0.31 percent and 0.18 percent, respectively, of the total number of machine tools. Among their 677,000 pieces of forging equipment were 104 pieces of numerical control forging equipment. At the end of 1985, the total capacity of power machinery in independent accounting enterprises at the county level and above was 310,000MW and electricity consumption was 293.4 billion kWh. The amount available per worker was just 11kW and the amount of electricity used per worker was 10,500 kWh. The figures for England and Japan in 1983 were 107,600 kWh and 69,600 kWh, respectively, so the difference is extremely obvious.

3. The contribution of technical progress to economic development. Analytical computations based on the Cobb-Douglas Production Function indicated that from 1981 to 1985, our average rates of growth in gross value of industrial output and net value of output were 11 percent and 11.4 percent, respectively. The respective figures were 41.5 percent and 40 percent from relying on capital inputs for achievement, 30.5 percent and 29.5 percent from relying on inputs of labor power, and 28 percent and 30.5 percent from relying on technical progress. It is quite apparent that these proportions are very small compared to the developed countries.

4. The number of new products, product quality, competitiveness, and other areas. In 1985, the value of new products in 3,556 key enterprises in China accounted for 12.5 percent of the gross value of industrial output in these key enterprises during that year. Major new products accounted for 4.3 percent of the gross value of their industrial output. The 1985 survey shows that the quality of two-fifths of China's existing major industrial products has attained international levels but another three-fifths of our primary industrial products are below international levels. Because of the few new product varieties and the relatively poor quality, China's products compete poorly in the international market. China's industrial product exports in 1985 totalled $24 billion. Although this was nearly double the 1980 figure, it only comprised about 1 percent of the total world volume of industrial product exports. Moreover, most export products were raw materials and initial finished goods, while machinery, electronics, and other high added value products accounted for a rather small proportion.

In addition, the survey indicated a trend toward worsening of the equipment aging situation over the past few years. In the 1985 industrial survey, 77 percent in large and medium-sized enterprises had enn in service life less than 15 years while 23 percent had been in service more than 15 years. The results of a survey of 125 large and medium-sized enterprises in 1989, however, showed that the proportion in service less than 15 years had dropped to 55 percent while the proportion over 15 years increased to 45 percent.

The above are the main industrial situations. In comparison, technical levels in China's industrial enterprises are somewhat stronger but the lag behind the developed countries is even greater in certain other industries.

It is precisely because of China's low technical levels that economic growth in China depends primarily on inputs of capital and manpower and is accomplished mainly through extensive expanded production to develop our

economy. It is also because of our low technical levels that China's industrial structure is still in a low-grade stage and changes in our industrial structure are rather slow. The speed of changes in the industrial structure, however, is an important indicator of economic development. Low technical levels have also been a direct cause for declining economic results in China and they have had extremely negative effects on further development of our economy and on improvements in people's living standards. According to data from the State Statistics Bureau, among the indices used to assess key enterprises, there was a decline in quality indicators in 48 percent of the enterprise between 1985 and 1989 and consumption indices rose in 52 percent of the enterprises. The profits and taxes realized per 100 yuan in capital fell from 23.8 yuan to 16.8 yuan and the profits realized per 100 yuan in income from sales dropped from 11.8 yuan to 6.3 yuan. There was a 58 percent reduction in profits realized in enterprises in the budget and the total losses doubled. Of course, there are several other causes for declining economic results but low technical levels undoubtedly are one major factor.

II. Enterprises Should Become a Primary Force in Promoting Technical Progress

Generally speaking, there are two patterns in promoting technical progress: 1) Research organizations are the main force in promoting technical progress. 2) Enterprises are the main force in promoting technical progress.

Scientific research organizations are generally non-profit types and their main source of funds is government allocations and civilian assistance. They also complete the scientific research projects they have been commissioned to do. Their primary objective is to pursue science and use the pursuit of science to eventually achieve the result of technical progress. Their characteristics are: 1) It is easy for this type of technical progress model to form its own independent scientific research system that has a relatively solid scientific foundation and easily forms technical reserves. 2) Scientific research organizations generally do not have profit as their goal. The main source of motive power for technical progress is not the pull of market demand but instead comes from the pursuit of S&T by scientists and engineers. For this reason, is usually is easy for phenomena to appear like emphasizing science but neglecting technology (in people's minds, science is valuable knowledge while technology is merely the technique of craftsmen), emphasizing research but neglecting extension, and so on. Blindness in research easily occurs. Frequently, advances are made in science and new technical principles appear in research, but they are hard to use in reality, which causes technology "overstocks". On the other hand, no forces are invested in research on new technology that is urgently needed in production, which causes technology "shortages", so the economic results of scientific research investments are rather poor.

The primary objective of enterprises is profits and they must be responsible for their own profits and losses. Thus, enterprise promotion of technical progress is a form of demand guidance and it is precisely because the objective of enterprises is profits that gives enterprises as the main force in promoting technical progress the following characteristics: 1) The objectives of technical progress are clear, the success rate is high, and schedules are short. 2) When scientific research and production are closely integrated, the returns to investments in scientific research are high. 3) Inter-enterprise competition causes rapid technical progress. 4) The profitability of technical progress in enterprises determines that enterprises will not make basic research and so on the target of their investments in research projects that cannot earn profits.

These two methods of promoting technical progress have both advantages and disadvantages and different scopes of appropriateness. Generally speaking, many non-profitable basic research projects, projects that do not produce benefits for long periods, and projects that consume large amounts of capital should mainly be handled by government investments and completed by research organizations as the main force. In contrast, those projects that do not involve hugh investments and have good economic benefits and produce results quickly should be completed mainly by enterprises.

For a long time, scientific research organizations have been the main force in promoting technical progress. Before reform, China's scientific research and production system basically was one in which scientific research organizations worked on scientific research, design, and development while production enterprises were responsible for product production. After reform, although we have done a great deal of work to promote integration of scientific research organizations with production enterprises and rapid conversion of technical inventions and innovations into forces of production, there have never been substantial changes in the phenomenon of "two pieces of skin" [separate foundations] for scientific research organizations and enterprises. On the one hand, from the perspective of scientific research organizations, because scientific research organizations are institutional units funded by government allocations, most S&T achievements are transferred without compensation. As a result, there has been no major change in the phenomenon of research personnel emphasizing research while neglecting extension, nor have there been any major changes in the phenomenon of blind scientific research directions and most S&T achievements stopping at the laboratory stage. Moreover, because the manpower and materials expended by scientific research units and scientific research personnel are not given the proper compensation, this makes it hard for scientific research organizations to form self-accumulation mechanisms and it damages the initiative of scientific research personnel, increases the financial burden on the state, and affects further state allocations to scientific research organizations. On the other hand, from the perspective of enterprises, the scientific research capabilities of enterprises themselves are very weak and they

lack technology development capital, so it is very hard for them to rely on themselves to promote technical progress. Moreover, if they import technology from scientific research organizations they also encounter restrictions like new technology from scientific research organizations not meeting enterprise needs, scientific research organizations having no enthusiasm for extending technical achievements, and so on. The data show that about 85 percent of enterprises at present feel that the levels of technical achievements from scientific research organizations are not high, while 75.9 percent of large enterprises and 71.9 percent of medium-sized and small enterprises have clearly expressed misgivings about accepting technical achievements from scientific research organizations in China.

The goals of technical progress are to promote economic development and improve people's living standards. It is precisely for this reason that the modern economically developed countries have been compelled to place scientific research and technology development work in enterprises. For example, expenditures by industrial enterprises on scientific research and technology development as a proportion of total national scientific research and technology development expenditures were 73.7 percent in the United States and 69.4 percent in Germany in 1983, and 71.6 percent in Japan in 1984. Development and research personnel in Japanese enterprises accounted for 63.2 percent of the total number of personnel in Japan in 1984 while their scientists and engineers accounted for 57.1 percent of the national total. In comparison, Chinese enterprises play a much smaller role in the area of technical progress. In 1989, expenditures by large and medium-sized industrial enterprises on scientific research and technology development in China accounted for 44.2 percent of the national total (including natural science research academies and institutes, science, engineering, agricultural, and medical colleges and universities, and large and medium-sized enterprises), while their R&D personnel accounted for 37.1 percent of the total in China and their scientists and engineers accounted for 26.7 percent of the total in China. In 1989, only 6,400 of 12,200 large and medium-sized enterprises in China had established technology development organizations, equal to 52.5 percent of the total. In 1989, expenditures on technology development in China's large and medium-sized industrial enterprises accounted for just 1.44 percent of their income from product sales during that year, and the proportion of expenditures on new product development was less than 0.5 percent. Moreover, expenditures on new product development in economically developed countries usually account for 5 to 10 percent of income from product sales during a year, or even somewhat more.

Much data shows that in the developed countries, enterprises play an extremely important role in promoting technical progress, whereas enterprises in China play a much smaller role in this area.

III. Viewing Intensive Enterprise Reform From the Perspective of Technical Progress

To achieve a rapid improvement in China's technical levels and make technology better serve the economy, it is undoubtedly correct to focus on the role of enterprises in technical progress and make enterprises a primary promoting force in technical progress. However, the present situation in China's enterprises makes them incompetent at the important task of promoting technical progress. This is manifested mainly in the following areas:

1. Technical forces in China's enterprises are weak and they do not have adequate technology development capabilities.

2. There is much resistance to technical progress in enterprises. At present, the main resistance to technical progress in China's enterprises is manifested in the following areas: 1) Excessive burdens on enterprises. 2) Enterprise contractual responsibility systems and plant manager term of office systems have caused obvious short-term behavior in enterprises and it is very difficult for enterprise leaders to place technical progress in an important position. 3) There is severe "acute unemployment" in enterprises which is worrying everyone. According to statistics from industrial departments, severe overstaffing is common in enterprises at present and it is very hard for enterprises to adopt labor-saving technology.

3. There is inadequate motivation for technical progress in enterprises. This is manifested in: 1) Enterprises have not fundamentally achieved responsibility for their own profits and losses. 2) The price structure is irrational, so excess profits earned via unreasonable price ratios instead of through technical progress. Statistics show that the profits and taxes realized per 100 yuan of capital invested in 1988 in independent accounting industrial enterprises under ownership by the whole people were 1.6 yuan in the coal dressing and extraction industry, 3.24 yuan in the petroleum and natural gas extraction industry, 56.85 yuan in the petroleum processing industry, 38.86 yuan in the rubber products industry, and 28.38 yuan in the chemical industry, so the highest industry was 35.53 times that in the lowest industry. In this way, the industries that earn excess profits do not use technical progress and models to earn high profits. Instead, they expend their main energies on extensive expanded reproduction, while industries that earn minuscule profits also lack capital for technical progress.

The above shows us that the present situation in China's enterprises prevents them from bearing the heavy burden of promoting technical progress. For this reason, we must intensify enterprise reform. The goal model for state-owned enterprise reform is to make enterprises become independent commodity producers and managers, which also means requiring enterprises to promote technical progress. Only when state-owned enterprises

become independent commodity producers and managers will state-owned enterprises become like the statement in the "Decision": "with a prerequisite of conforming to state plans and management, enterprises have the right to select flexible and diversified management patterns, the right to arrange their own production, supply, and sales activities, the right to have and allocate their own retained capital, the right to do their own hiring and firing in accordance with stipulations and to recruit and select work personnel for their own enterprises, the right to make their own decisions on methods for using workers and types of wages and bonuses, the right to determined product prices in their enterprise within the scope allowed by the state, and so on." Moreover, only then can they "make their own management decisions, take responsibility for their own profits and losses, have the ability of self-upgrading and self-development, and become legal persons with specific rights and duties." Only in this way will enterprises have the motive force for technical progress because the direct beneficiaries of technical progress are the enterprises. Only in this way will enterprises have pressure for technical progress because only by relying on technical progress, improving product quality, increasing product variety, and raising enterprise management levels can enterprises be guaranteed of success in intense competition, and only in this way will enterprises be able to overcome resistance to technical progress because enterprises will be legal persons with specific rights that have legal protection.

Of course, much work must be done to attain this goal model. At present, state-owned enterprises are still quite distant from true commodity producers and managers. It can be said that they have started to become commodity producers and managers but they are far from completing this process. At present, to fully foster the important role of enterprises in promoting technical progress, we must carry out reform in these areas:

1. Intensify reform of the S&T system, solve the problem of weak technical forces in enterprises. The concrete idea is: in the future, the state should mainly invest in research organizations that are involved in basic research, national defense research, public benefit-type research, large project research, and so on. Research organizations involved in applied research and development research that could earn profits should gradually be integrated with the economy. This can be done in three ways: 1) Establish S&T dominated- type enterprises with these research organizations as the main force. 2) Merge with large enterprises or enterprise groups. 3) Use the technology market to integrate enterprises with scientific research organizations. This would directly or indirectly solve the problem of weak technical forces in enterprises.

2. When new enterprise management mechanisms are still not in place, we should further perfect enterprise contractual responsibility systems to solve the problem of short-term behavior in enterprises, and the issue of technical progress should be prominent in the contractual responsibility regulations so that S&T progress indices are one main aspect of assessing administrative contractual responsibility. With a prerequisite of fair competition, we should encourage plant managers to assume successive contractual responsibility to move them toward longer-term behavior.

3. Reform the enterprise allocation system, encourage the initiative of enterprise employees for technical progress. Employees involved in technology development should be given more favorable treatment. For technical progress projects, we should use fair competition and implement technical contractual responsibility, establish clear reward and punishment systems for technology development personnel, and truly achieve more pay for more work.

4. Reform the profit retention system in enterprises, raise enterprise depreciation levels, open up financial channels for enterprises in many areas, provide capital guarantees for enterprise technical progress.

5. Develop enterprise groups. The large scale, great technical strengths, and sufficient capital of enterprise groups give them advantages in technical progress that regular enterprises do not have. For this reason, we should make a great effort now to develop enterprise groups and in particular should be concerned with developing enterprise groups that integrate enterprises with scientific research organizations so that enterprise groups become a central force in technical progress.

6. Improve the macroeconomic environment, devise ways to reduce the burdens on enterprises, implement price reform, create a fair environment for enterprise competition.

Goals of Science and Technology System Reform

92FE0417D Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 2 Mar 92 p 3

[Article by Hu Lezhen [5170 2867 4176], National Science and Technology Commission, Science and Technology System and Administration Institute: "The Overall Goals of China's Science and Technology System Reform"

[Text] Science and technology is the primary production force. China's modernization depends mostly on progress in science and technology, and problems in the science and technology system are a major factor impairing progress in science and technology. In order to continue the intensification of reform, this article presents some preliminary thoughts about reform of the science and technology system, overall goals, and key points in reform.

1

The overall goal of reform of China's science and technology system must be the building of a new system that is in keeping with the laws of development of science and technology per se, that fits in with China's socialist

planned commodity economy, and that closely links science with the economy and the society, mutually advances them, and provides for their coordinated development. Specifically, what is needed is the building of a competitive, multi-component scientific and technical operating system that is in keeping with the nature of all kinds of scientific and technical activities. It means building a scientific and technical personnel management system that combines organization and personnel assignments, permitting two way selection [the employer selecting the employee and vice versa]; building a macrocontrol system for science and technology in which indirect control is paramount for the standardization of science and technology management; reorganization of the research and development system, the key component of which is the transfer to business enterprises of independent research institutes; and the building of a socialist system for sustaining and safeguarding scientific and technical work that is in keeping with a socialist planned commodity economy. Reform can provide the science and technology system with the basic features of "system openness, personnel movement, widespread coordination, fair competition, micro-organization self-management, and coordination of the government system itself."

We believe that thorough reform of the science and technology system is a complex, long-term task. Current progress in reform is rational, but it is transitional in character to a very large extent. The overall goal of reform is, in essence, a change from the old system to a new system.

2

Realization of this goal requires reform of the science and technology operating mechanism, and restructuring of the science and technology system. The two are interdependent, mutually conditional, and intertwined. In an overall sense, reform of the operating mechanism is paramount.

Reform of the science and technology operating mechanism requires correct handling of macro-decision making, and regulating its relationship to micro-operations. A smooth micro-operating mechanism is the foundation for reform of the entire operating mechanism. The main task in macro-decision making and regulation is to create a fine climate for micro-operation, and to guide micro-operation in playing a guiding and supervisory role. Reform must center around "a single nucleus and two main points." "A single nucleus" means the nurturing of a competition mechanism to build a climate of fair competition. A sound competition mechanism is what fundamentally distinguishes the new and the old system. The "two points" are: the correct handling of the correlation between plan and market; and the correct handling of the correlation between government and micro-organization, and the correlation between government agencies. It includes the following specifics:

First is the building of a multi-component national policy-oriented science and technology operating mechanism. This means institution in the basic research field of a self-governing mechanism for scientists under state policy guidance and with support from state funds; and institution in the applied research and technology development field of a mechanism that combines state plan with market regulation. Except for common social needs, which are to be provided for by state plan, all else should be carried out through technology markets insofar as possible. During the initial stage of socialism, state science and technology plans will continue to play an extremely important role. The scope and the role of technology markets will gradually expand and become stronger.

Second is attendant reform of the scientific and technical planning, the funding, the materials supply, the labor affairs systems and the system for translating research into products, thereby opening up channels for scientific and technical tasks, and for scientific and technical cooperation for the dovetailing of all segments of scientific and technical activity.

State scientific and technical planning should be changed from comprehensive planning to mostly project-by-project planning, and the percentage of guidance plan projects gradually increased while the percentage of command style plan projects is reduced to the minimum. A greater competition mechanism component should be introduced into the implementation of plans, only the best selected to carry out projects.

A multi-component science and technology investment system that includes central government and local government financial institutions, enterprise capital, financial credit, money that industries have collected, and domestic and foreign donations should be gradually fashioned.

A mechanism should be established to organize the movement of scientific and technical personnel that links personnel assignments to "two way choices" [employees and employers choosing each other] and integrating it with reform of personnel management, the wage system, and the bonus system in the fashioning of a complete management system that is able to stir the interest of the rank and file of scientific and technical personnel, and accelerate the maturation of young scientific and technical personnel.

Greater motivation should be provided to enterprises to advance technologically in close association with economic system reform for the fashioning of a system that encompasses finance, credit, price, tax collection and technical supervision policies and regulations in order to promote technological progress in enterprises.

The technology innovation mechanism should be improved by moving ahead with reform of the planning system, and by giving impetus to the industrialization of high- and new-technology, creating a mechanism to

translate the fruits of technological research in which commercialization is the main channel.

Third is optimization of the government administration function. Government's main administrative function for science and technology is regulation and control of macro-policy, the main tasks of which are as follows: selection of a scientific and technical development strategy; formulation of scientific and technical policies and regulations, coordination of scientific and technical plans, and coordination of scientific and technical plans with economic and social development plans; and regulation and control of the investment and distribution of scientific and technical outlays throughout society. Since the state is the administrator of public endeavors in society as well as the owner of state assets, the two must be structurally separated to prevent a conflict of roles. Making full advantage of the leading role of government in the development of national science and technology requires greater emphasis on government's stimulating, guiding, and coordinating functions.

Readjustment of government's functions requires a change in methods from direct control to indirect control, and from the rule of people to the rule of law. The application of regulation and control must also change away from administrative interference toward economic and legal methods primarily. This includes the following: establishment at the highest government level of an authoritative science and technology coordination apparatus; rationally dividing up the jurisdiction of each level of government and each agency at the same level of government in accordance with the principle of "appropriate centralization and decentralization of authority." In order to spell out responsibilities and as an aid to supervision, organizationally, the structures for administering research organizations and for the distribution of scientific and technical resources should be separate; and policy, policy implementation, and supervision should be separate too. An advisory organization should be established in high level decision making organs to ensure "separation of planning and decision making." The science and technology administrative functions of units in charge of the economy at all levels of government should be increased, thereby linking technology to the economy in order to avoid the abuses that come with a cleavage between higher and lower levels. Industries should control planning and expenditures rather that government departments, etc.

In addition, an overwhelming majority of the things that government does should be gradually placed under socialized control as a means of creating conditions for micro-organizations themselves to exercise control.

Fourth is the founding and perfection of a system for supporting and safeguarding the socialization of scientific and technical work. This supporting and safeguarding system should be made up of the following 10 sub-systems: A system in charge of information; a system for the socialization of scientific and technical investment; a system for the supply of materials for science and technology: a system for the socialized management of scientific and technical talent; a system for the diffusion of academic findings; a system that serves as a medium for the translation of research findings into technology; a system for technical supervision, a system in charge of scientific and technical legal matters; a trade association; and academic groups.

3

Attendant adjustments should be made to the main structure of the science and technology system as reform of the science and technology operating mechanism progresses, and as the climate of reform warrants. The emphasis of such adjustments should be on the following:

Redirection and reorganization of the research and development system, making three changes in the overall pattern as follows: 1. a change from the walled-off kind of research and development system in which barriers exist between higher and lower levels, turf is strongly defended, organizations are "large and all inclusive" and "small but all inclusive" to a research and development system in which there is broad cooperation both inside and outside, and in which a mutually beneficial interchange occurs. At the same time, positive efforts must be made to create conditions for gradual development toward internationalization. 2. gradual change from research under direct control of government departments to research done by industrial enterprises, and a change from "government-directed research" to "enterprise-directed research," thereby enabling enterprises to become the dominant force in the development of new products and new technologies, both enterprises and government becoming principal investors in research and development. 3. change from an administrative hierarchical style, static organizational structure to a social network style, dynamic organizational structure. The emphasis in building a system for assimilating and developing technology in industrial enterprises should be on large enterprises building research and development organizations of a certain size and level that possess substantial ability to develop new products and new technologies. Some especially large enterprises among them should possess substantial ability to do applied research and to develop high- and new-technologies. Research institutions and enterprises should be encouraged to form mergers and to set up a stock share system for the gradual shaping of scientifically and technically sophisticated entrepreneurial blocs possessing great strengthen in terms of talented personnel, funds, and equipment, or externally-oriented entrepreneurial blocs that can compete internationally. In the process of competing, all trades and enterprises should gradually fashion a structure that is able to assimilate and develop technology in a rational way.

Building of an agricultural science and technology system based on the need for developing large scale modern agriculture (including farming, forestry, animal husbandry, and the fishing industry) that is divided into

three levels as follows: 1. a nationwide agricultural research and development organization that is primarily responsible for undertaking basic research and across-the-board research and development. Scientific research organizations based on present day farming, forestry, animal husbandry, and the fishing industry should be selectively organized and given strong state support. 2. A regional agricultural science and technology system. Various regional agricultural research and development centers should be organized nationwide on the basis of agricultural zoning and the character of individual regions, such centers having research organizations of various different kinds under their jurisdictions. In addition, agricultural research organizations and large universities should build jointly with provinces, prefectures and counties either modern agricultural development experimental zones that combine education, research, experimentation, and operations, or externally oriented agricultural technology development blocs. 3. Build and perfect a completely socialized network for the popularization of rural technology and to provide full services, opening channels for the infusion of science and technology into rural villages.

The reorganization and separation of independent scientific research institutions for a change in the present situation of "large scale, low level" research organizations under direct jurisdiction of government agencies will require a decrease in overall scale in order to concentrate investment. This will mean that overall size and speed of development will be generally what the national exchequer is able to support. In the separation and reorganization process, government agencies must maintain a highly skilled scientific research corps. It must also found open scientific laboratories and scientific research centers that cut across project lines; the government must support the operation of research and development organizations for the public benefit. Most of the other scientific research organizations will find an optimum direction for development as they themselves decide, developing into vanguard style enterprises for science and technology, becoming technical development units for enterprises, changing into technical development centers for industries, or becoming scientific research organs not under higher level control that will use the market as a stage on which they develop through competition, etc. After separation and reorganization, scientific research organizations under government agency jurisdiction will administer themselves in accordance with the principle of self-rule, instituting an institute director responsibility system under leadership of a council. So long as they respect national policies and laws, other scientific research organizations may administer themselves as they see fit.

China Science Association States Key Tasks for 1992

92FE0401G Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese 15 Feb 92 p 1

[Article by Li Jianguo [2621 1696 0948]: "China Association For Science and Technology Sets Key Tasks For 1992"]

[Text] The key tasks of the China Association For Science and Technology for 1992 were recently approved by the Association's Fourth Standing Committee. The key tasks set the guiding thought, the key tasks, and 11 major activities of the China Association For Science and Technology for 1992.

The overall guiding thought in the work of the China Association For Science and Technology in 1992 is as follows: to carry out to the full the spirit of General Secretary Jiang Zemin's important speech to the "Fourth Congress" of the China Association For Science and Technology, to uphold science and technology as the first source of productivity, to promote a genuine shift in building of the economy to the path of reliance on scientific and technical progress and improvement of the quality of the work force, to implement the policies and decisions of the Central Work Conference and the Eighth Plenary Session of the 13th Party Central Committee pertaining to the good performance of large and medium size state-owned enterprises, improve agriculture and rural work, actively perform the glorious responsibilities of people's organizations, bring into full play the distinctive superiority of these organizations, unify thinking, work hard to bring tasks to fruition, concentrate energies on performance of several major matters, and do the work of the Association with greater elan and more effectively.

The China Association For Science and Technology posed six requirements for doing a good job in 1992 as follows: 1. carry out the spirit of the Central Work Committee to make a contribution to the good performance of large and medium size state-owned enterprises; 2. carry out the spirit of the Eighth Plenary Session of the 13th Party Central Committee to improve service to agriculture and rural work; 3. actively support the participation of young scientific and technical workers in domestic and foreign academic exchanges to accelerate the healthy growth of young talent; 4. take advantage of people-to-people channels in seizing opportunities to advance scientific and technical exchanges and to cooperate internationally and on both sides of the Taiwan Strait; 5. publicize science and technology more to promote the building of socialist spiritual civilization in the scientific and technical field; and 6. do more organization building and improve management the better to serve scientific groups and workers in science and technology.

By way of carrying out the spirit of the two important Central Committee conferences, the China Association For Science and Technology made academic exchanges, serving policies, socialized scientific and technical services, as well as promoting the growth of young scientific and technical talent, publicity and publication, organization building, and scientific and technical exchanges between both sides of the Taiwan Strait key tasks. In connection with these key tasks, the China Association for Science and Technology will conduct 11 major activities during 1992. These 11 major activities are as follows: 1. survey Huang He Basin flood disasters to

recommend ways to reduce disasters; 2. conduct investigation and study, and make recommendations about ways to improve large and medium size state-owned enterprises and entrepreneurial groups, as well as to develop further rural specialized technical research associations; 3. convene the Sixth Consulting Work Conference; 4. possibly convene, in conjunction with the CPC Propaganda Department, an experiences exchange conference on the "discuss, compare, and build" campaign; 5. possibly conduct, in conjunction with the State Statistical Commission and the State Council's Production Office, a general exchange of experiences about the competition to "stress the ideal and compare contributions" by way of giving impetus to development of this campaign; 6. convene the Association's first annual young people's academic conference; 7. conduct investigations and studies for the purpose of making policy recommendations; 8. organize the third young people's science and technology awards evaluation; 9. determine the editorial policy for the inauguration of an Association newspaper and the Association's periodical, KEJI DAOBAO [SCIENCE AND TECHNOLOGY BULLETIN], and reorganize the organization; 10. prepare a report for the State Council on learned society stability and reform matters nationwide, and coordinate it with departments concerned; and 11. do a good job on the "Dunhuang Ancient Science and Technology Exhibit," which is to be presented in Taiwan.

Director Zhang on National Science Foundation Work

92FE0276D Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 31 Dec 91 pp 1, 2

[Article by Zhang Cunhao [1728 1317 3185], director of the National Natural Science Foundation: "Raise Science Fund Work to a New Level"]

[Excerpt] [passage omitted]

I. The Science Fund Work Situation During the Seventh 5-Year Plan

Under the leadership of former director and current honorary director professor Tang Aoqing [0781 2407 1987], the Foundation underwent a step by step and arduous process from creation to development during the Seventh 5-Year Plan. During the 5-year period, based on three levels (overall, key, and major) and seven project categories (free application projects, Young Science Fund projects, high-tech new concept and new idea exploration projects, regional science fund projects, key projects, major projects, international cooperation projects, and in addition the establishment of the Tianyuan Mathematics Fund), a total of more than 16,000 projects were approved for grants (including subtopics of major projects), with the grants totalling more than 640 million yuan and actual allocations more than 530 million yuan. The grants involved more than 1,000 units and 80,000 people (about 130,000 people-times) throughout China.

Practice in Science Fund work during the Seventh 5-Year Plan confirmed that the Science Fund system was a success and that it conformed to China's national conditions. It was successful in that it can foster nonconventional and multidepartmental advantages and better embody the work characteristics of basic research, increase the utilization rate of funds, and motivate initiative in all related areas to promote improvement in Science Fund projects and overall scientific research levels, and it was effective in forming an excellent work style of struggling upward and dedication to science. Thus, the Science Fund system has found a good mechanism for S&T decision making and management work and has also confirmed that the corresponding decisions of the party concerning reform of the S&T system were correct.

II. Main Work For 1991

In 1991, a change was made in the leading organs of the Foundation and all aspects of work were undertaken on the basis of work done in the preceding session.

First, organizational mechanisms were perfected and readjusted. There was preliminary research and formulation of the National Natural Science Foundation's 10-year program and Eighth 5-Year Plan outline plan and the corresponding work was done to improve Science Fund expenditures and the correct allocation and utilization of funds. Definite advances were made in research work on discipline development strategies.

In a situation of substantial shortages of state finances during 1991, an additional 25 million yuan was given to the Natural Science Fund, a yearly increase of almost 17 percent, reaching 176 million yuan. A total of more than 14,000 overall projects were received and processed during 1991 (including 419 key projects). Approval was given to 2,627 free application projects and 470 Young Science Fund projects, for which total funding was increased from 12 million yuan in 1990 to 16 million yuan in 1991. Grants were approved for 148 high-tech new concept and new idea projects and grants were approved for 149 local science fund projects.

We began implementing new project establish, evaluation, and management methods for key projects in 1991, and we have already approved 79 project grants. We have approved 14 projects to serve as the first group of major projects during the Eighth 5-Year Plan.

The Fifth National Natural Science Award Review work assigned by the State Science and Technology Commission was organized and implemented by the various academic departments in the Foundation. There were 53 projects given awards during 1991 (including one top-secret project), including 10 second-place awards, 31 third-place awards, and 12 fourth-place awards.

During 1991, we were commissioned by the State Planning Commission to organize evaluations of seven key state laboratories and we were commissioned by the State Science and Technology Commission to organize

evaluations of the allocation of operating subsidies to 143 key state laboratories and departmental open laboratories (usually called open laboratories).

During 1991, on the basis of the spirit of the CPC Central Committee and State Council concerning the profound understanding that S&T are the first force of production, we made major efforts to raise the S&T consciousness of all the people of China, integrated promoting the development of basic research with Science Fund work, and coordinated with the relevant departments to undertake the required study and propaganda activities. We feel that:

1. Raising S&T consciousness should include raising consciousness of basic research or basic-type research. Reinforcing S&T work should include reinforcing basic research (including applied basic research) work. Basic research at present is not just a backup force and reserve for S&T and economic development but is also the third level of S&T development. In reality, it is the vanguard and source of new technology and new inventions. Major breakthroughs in basic research not only open up people's cognitive abilities and affect progress in social development from many aspects, but they also frequently lead to the formation of new technologies and industries and have a revolutionary impact on high and new-tech and economic development. The entire world is now making the training of high-level S&T personnel a key task in competition of comprehensive national strengths and economic development strategies. Moreover, basic research is an important route for training high-level S&T personnel.

2. The primary task in the Foundation's work is to support basic research and set even higher demands for our work in the new circumstances. We must conscientiously and meticulously do this third-level basic research work well, more consciously strengthen the integration and coordination of this work with first and second-level S&T work, and make our own contributions to the state's overall S&T development activities. At the same time, we should do research on how to more effectively use the Science Fund to play an important role in the area of training and discovering high-level S&T personnel.

III. Ideas for Work in 1992

May 1992 is the 10th anniversary of the founding of the National Science Fund (beginning with the establishment of the Science Fund oriented toward all of China by the Chinese Academy of Sciences). This is a day that should be commemorated by Science Fund workers and all those in scientific circles. We will continue making major efforts to study, propagandize, and implement the Marxist thesis that S&T are the first force of production, summarize experiences, intensify reform, and raise Science Fund work to a new level. For this purpose—

1. Continue to adhere to the three-level grant configuration in the Science Fund. In the future, overall projects are still the most important and basic category among Science Fund projects and account for about 70 of total expenditures. Key projects have powerful disciplinary qualities and are a bridge linking overall projects with major projects, and we should continue to strengthen our support for them. During the Eighth 5-Year Plan, we plan to provide grants to 300 key projects at an average grant of about 500,000 yuan per project. During the Eighth 5-Year Plan we plan to arrange 35 major projects at an average grant of about 2 million yuan per project.

2. Integrate equal competition with appropriate policy slanting. In 1992, we will continue to adhere to equal competition while at the same time integrating with and considering the state's real needs, the objective conditions of disciplinary development and staffs, and other factors to implement the necessary foci and slants in project grants. The areas of the slants include: China's emerging and multidisciplinary projects, projects with rather good foundations that conform to disciplinary development trends and offer the hope of producing rather good achievements, and projects with rather strong skilled personnel forces, good disciplinary leaders, and clear scientific research directions; projects commissioned by key state laboratories; and basic research projects with unique requirements and major significance for the national economy such as in agriculture, the environment, and so on. For truly necessary research projects, we will open up grant channels for medium-sized and small special-purpose instruments and equipment as appropriate.

3. Further improve Young Science Fund work. We will also continue to perfect and improve Young Science Fund work during 1992, make it a rational proportion of overall expenditures, and make appropriate increases in support for it.

4. Make contributions to fostering the scientific spirit for our entire nationality. Comrade Song Jian [1345 0256] sent us a letter with attachments on 9 July 1991 suggesting the "establishment of a truly Marxist scientific spirit for all of our nationality". In 1992, we should use Science Fund work for study and practice regarding the basic principles and methods of Marxism, foster the scientific attitude of beginning with reality in everything and seeking truth from facts, and encourage taking the route of integrating science with practice and integrating scientists with the worker and peasant masses; pay attention to and prevent the pursuit of fame and wealth, taking another's place by assuming their name, data fabrication, testing irregularities, and other fraudulent phenomena, improve the ethical qualities of S&T circles, promote a fundamental improvement in the social atmosphere and development of construction of the two types of civilization [material and spiritual]; further reinforce management and inspection of work in the areas of Science Fund projects, natural science awards, evaluation of state open laboratories and so on, and immediately deal severely with any fraudulent phenomena as soon as they are discovered.

We believe that under the leadership of the CPC Central Committee and the State Council and with the great support of scientific circles and all areas of society, our work will be done even better in all areas in 1992.

Development of Science Information Network Accelerated

92FE0155A Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 15 Oct 91 p 1

[Article by reporter Liu Jian [0491 0494]: "Development of China's S&T Information Network Accelerates, Fully Fostering the Role of S&T 'Eyes and Ears', 'Pathbreakers', and 'Staff Officers'"]

[Text] I learned from the "National S&T Information Bureau and Institute Directors Work Conference" held recently in Urumqi that China's S&T information circles now have over 400 independent information organs and more than 30,000 specialized information personnel. Added to the information personnel in plant and mining enterprises, institutions of higher education, and companies, we have now formed a powerful S&T information staff with about 100,000 personnel.

S&T information work is an important part of S&T work as well as the most vigorous factor in S&T activities. China's S&T information activities have continually developed and grown over the past 30-plus years and they have provided a large amount of information services of all forms to China's scientific research, production, management, policymaking, and other battlefronts. This is particularly true since reform and opening up. Under the guidance of the principle of "opening up information resources, serving the four modernizations drive", China's information work has undergone new development, continually destroyed traditional models, and developed the fields of compensated service and extended service, which have further strengthened its close integration with S&T, the economy, and society and fully played the role of "eyes and ears, pathbreakers, and staff officers". At present, 30 of China's provinces and municipalities and more than 40 industries have established independent information organs and are forming on an initial scale a rather powerful national abstract support system, information research and policymaking advisory service system, computer search service system, and many other types of functional service network systems that have effectively promoted comprehensive development of China's S&T and economy.

This conference decided that the primary tasks of China's S&T information capital construction during the Eighth 5-Year Plan are: gradually form an S&T information computer service network, basically complete a rationally deployed abstract support and service system for primary industries and some provinces and municipalities, and gradually form a situation research and consulting service system to make a contribution to S&T program and plan formulation, major project discussion, and key technology research, and to provide services to promote modernization of equipment, transform the technical situation in key industries, extend S&T achievements, and promote the development of high and new technology and industry.

Chinese S&T International Cooperation Reviewed

92FE0276H Kunming YUNNAN RIBAO in Chinese 27 Nov 91 p 4

[Article by reporter Yang Zhaobo [2799 0340 3134] and trainee Lang Guohua [6745 0948 5478]: "Chinese Science and Technology Take a Big Step Toward the World, A New Omnidirectional Configuration of International S&T Cooperation and Exchange Has Taken Shape"]

[Text] Under guidance of the principle of reform and opening up, China has made significant accomplishments in international S&T cooperation. We have opened the gates and faced the world, undertaking official and civilian bilateral and multilateral omnidirectional S&T cooperation and exchange on a world scale and a new multilevel, multichannel, and multiform international S&T cooperation configuration has now taken shape.

China has now established S&T cooperation and exchange relationships with 108 countries and regions, including the signing of intergovernmental S&T cooperation agreements or economic and trade S&T cooperation agreements with 58 countries. We have fought for our status in more than 30 organizations related to science and technology, including the United Nations system UN Science and Technology Development Commission, Science and Technology Promotion and Development Center, S&T Fund System and UNESCO, the United Nations University, International Atomic Energy Agency, World Health Organization, World Intellectual Property Organization, and others. Moreover, cooperation and exchanges are even more vigorous and broad-ranging between all regions and all departments in China as well as the scientific research units under their jurisdiction and institutions of higher education with counterpart organizations in foreign countries. The Chinese Academy of Sciences has signed over 50 academy-level cooperation agreements with science academies or scientific research organizations in more than 30 countries and regions. The National Natural Science Foundation has established cooperative relationships with 12 funding organizations in the world. The China Science and Technology Association and scholarly groups under its jurisdiction have joined a total of 192 international S&T organizations and assigned leading members to 39 organizations of the International Science Union. China is a member of more than 280 international S&T scholarly organizations. One-third of the 344 pairs of friendship ["sister"] cities that have been set up between China and foreign countries have undertaken S&T and economic exchanges. According to the State Science and Technology Commission's International Science and Technology Cooperation Bureau,

there were more than 12,800 official and civilian S&T cooperation and exchange projects between China and foreign countries in 1990 involving visits by more than 47,800 personnel, increases of 11 times and 7.5 times, respectively, compared to 1978.

The role of international S&T cooperation and exchanges in China's socialist construction and development of relationships with the outside world is becoming increasingly apparent, as are the economic benefits. Officials in the State Science and Technology Commission provided this outline:

1. International S&T cooperation has effectively promoted economic cooperation. We have used S&T cooperation and exchanges to obtain information and make technical comparisons that have effectively promoted economic trade cooperation and exports of Chinese technology and technological products. For example, China has used S&T cooperation to open up the international market for high and new-tech products like bismuth germanate, barium borate, niobium-iron-boron permanent magnet material, infrared transducers, and so on.

We have studied advanced scientific management methods and advanced technology in foreign countries. China's nuclear safety systems, S&T statistics systems, science funds, high-tech development zones, and so on were established by borrowing from advanced experiences in foreign countries and integrating with China's concrete conditions. The Beijing Positron-Electron Collider was developed via international S&T cooperation and we utilized technical guidance by experts from foreign countries during the design and construction processes. China has used international S&T cooperation to develop mixing and preparation technology for residual oil catalysis and cracking that can be extended and transferred to the world. Studying technology from foreign countries also improved the quality and reduced construction schedules for the Jing-Qin [Beijing-Qinhuangdao] railroad and the Dayaoshan Tunnel project.

2. We have made many important achievements via Chinese-foreign cooperative research, joint surveys, and joint development, utilizing equipment from foreign countries, and absorbing advanced research methods from foreign countries. For example, China has undertaken international S&T cooperation in space materials science, life science, microgravity, and other areas to promote improvement in China's space science research levels. The nuclear magnetic resonance imaging scanner developed through cooperation between China and the United States has attained advanced world levels. The Sino-French joint survey of the Himalayan Mountains produced breakthrough-type advances in plate tectonics. The establishment of the Sino-Japanese jointly-run Kunming Paddy Rice Variety Resource Institute and Beijing Integrated Meat Institute, the Sino-Canadian jointly-run Seawater Breeding Research and Training Center, and other jointly-run research organizations have played a positive role in improving China's R&D capabilities in these fields. They have trained large numbers of management and technical personnel for China. All ministries and commissions of the central government as well as local areas have joined with foreign countries for jointly running many unique specialized training centers. The European Community provided grants to establish eight energy resource training centers in China that have trained more than 3,000 people. The Chinese-United States Dalian Industrial Management Training Center has trained more than 2,500 people. In addition, China has also selected and sent large numbers of S&T personnel to foreign countries for advanced training. More than 2,000 technical personnel have been sent through the Japan International Development Organization's Institutional Group channel. China has also trained large numbers of S&T personnel for Third World countries. The Ministry of Public Health has trained more than 3,000 acupuncture and moxibustion doctors from 120 world nations and regions at the three acupuncture and moxibustion centers in Beijing, Shanghai, and Nanjing. Beginning in 1989, the State Science and Technology Commission has held training classes for Third World countries in marine biology, vegetable cultivation, ceramics production, and other fields that have been welcomed by Third World nations.

3. China's influence has been expanded and we have improved the international status of Chinese S&T personnel. The scholarly levels and personnel quality China's S&T personnel have attracted the attention of international colleagues through international S&T cooperation and exchanges. China currently has more than 350 scientists working in international organizations and some have received consecutive reappointments. State Meteorological Administration director Zou Jingmeng [6760 4552 5536] was also recently elected as chairman of the International Meteorological Organization.

China's S&T cooperation with foreign countries is established on a foundation of equality and mutual benefit. Many international friends have said that "we have always been interested in developing S&T cooperation with China and we are confident of success". One authority's assessment was that "the reason for this is that China has a stable political and economic situation, a vast market and abundant resources, and many skilled personnel".

Further Study on Internationalization of Chinese Enterprises

92FE0276B Taiyuan JISHU JINGJI YU GUANLI YANJIU [TECHNOECONOMICS & MANAGEMENT RESEARCH] in Chinese No 6, Dec 91 pp 7-10

[Article by Zhu Guanxin [2612 7070 9515]: "A Fifth Discussion of Internationalization of Chinese Enterprises"]

[Excerpt] [passage omitted]

I. The Current World Economic Situation and Internationalization of Chinese Enterprises

In the 1990's, with the surging development of the world's forces of production and high S&T, there is a trend toward the development in greater depth and breadth of the internationalization of economies, production, and capital. Now, a state of intersecting, complex competition and cooperation has appeared in the economic relationships among all countries. Among the developed nations as well as the underdeveloped nations, interdependence, mutual cooperation, and mutual integration surpass mutual opposition and mutual competition. We must take note of one fact, however. Victory by the superior and discarding of the inferior is still a law that is observed by economic development in the world. Japan has now become a world economic power. How did the Japanese economy become so vigorous? Everyone knows that Japan's economic takeoff occurred from the 1960's to the 1980's. The economic trend in the world at that time was that several developed countries had already taken over some international markets and the developing nations also established various types of tariff barriers to protect their country's economies. After the war, industrial production technology in Japan lagged nearly 30 years behind the developed nations of Europe and the United States. To breach the tariff barriers and catch up with the developed nations of Europe and the United States, Japan took a sober look at its need to open up overseas markets. Opening up overseas markets required stronger enterprise competitiveness. Where would this ability come from? Japan began focusing on technical progress in the 1950's and imported over 30,000 items of technology from foreign countries, spending more than $13 billion in technology software expenditures. After the 1960's, Japan focused mainly on absorption, digestion, and innovation of the imported technology without regard to the investment of huge amounts of capital and manpower. This was their so-called "absorptive strategy". It was precisely because the Japanese government took a long term view and resolutely accelerated technical progress in enterprises and staunchly pursued enterprise internationalization that its development during the 1980's eventually turned Japan into a world "economic power" and maintained the highest growth rate among the developed nations. Moreover, Japan's inflation rate was the lowest in the world throughout the 1980's. It was because of these factors that the yen became increasingly stronger. In the 1980's Japan's per capita GNP surpassed the United States and it became the world's biggest capital surplus country. In New York, I personally saw the large buildings purchased by Fuji, Matsushita, and other Japanese companies in Manhattan. This shows that Japan's economy is truly respected in the world. In addition, South Korea, Hong Kong, and Taiwan, these resource-poor regions, all used internationalization and vertical and horizontal trade to develop their economies.

There is one point that we must soberly see, which is that regardless of whether we are speaking of Japan, South Korea, Hong Kong, or the Taiwan region, they all relied on the huge market in the United States. Thus, when the United States feels a chill they catch a cold. The reason is that many economic indicators show that the United States still has the highest production capacity in the world, it is still the world leader in university education and the service industry, and its economic scale is twice the size of Japan's.

However, if we take a comprehensive look at the world as a whole from the economic perspective, it is easy to see that the United States is facing a challenge at the intersection of centuries and that its economic supremacy is gradually weakening and has basically declared that it is collapsing. The linkage of the North American region via free trade agreements between the United States and Canada, the post-unification European Community (EC), and the northeast Asia region will represent the world's economic situation in the 1990's. Moreover, Eastern Europe and the Soviet Union are now taking note of the success of China's open door policy and reform policy. They are now making a transition to an open market economy. We also should pay sufficient attention to this.

In summary, I feel that the achievement of internationalization of China's enterprises will be restricted by a whole series of social and economic factors. Moreover, it is a complex social transition, which means that a specific social environment is required to internationalize China's enterprises. In particular, it requires definite comprehensive national strengths as a reserve force. Analysis of China's present economic situation shows that S&T progress is one of the main factors restricting the pace of internationalization in China's enterprises. Although the replacement of low S&T by high S&T can be viewed as a law, the replacement process will not be achieved automatically. It is subject to restriction by system, policy, and other factors. Everyone knows that the huge force of the market in developed countries has promoted S&T progress in enterprises. The governments of many countries have viewed S&T as their national foundation and adopted economic, legal, and administrative measures in a major effort to promote S&T progress in enterprises and struggle incessantly for commanding heights in high S&T. However, China's markets at present are poorly developed and incomplete, and their force in promoting S&T progress is limited. This type of linkage to the international market falls far behind the more ideal situation of high foreign exchange earnings and high results. Although the commodities we export have changed from dominance by elementary products to dominance by finished industrial products, they are still light and textile industry products, minerals, farm products, fuels, and so on. Moreover, most light and textile products are of a labor intensive type and have rather low grades and added value. The Chinese government has now acknowledged that we must unify overall S&T work in society on a whole-society scale. Didn't the State Science and Technology Commission and State System Reform Commission's "Decision

on Intensive Reform of High- and New-Tech Industry Development Zones and Promotion of High- and New-Tech Industry Development" on 6 October 1991 explain this precisely? This is exactly the fact. Without forming a complete social environment in ideology, organization, policies, laws, and management to benefit S&T progress in enterprises and instead continuing to do as we did in the past to artificially isolate the S&T system internally and the S&T system from the inherent internal organic mechanisms of the economic system and the enterprise system and lacking an authoritative and unified S&T progress decision making and guidance system, achieving the internationalization of China's enterprises would be merely empty talk. Now China at long last has an intense desire and excellent environment opened in all directions for developing science and we can be confident that as time passes even greater steps will be taken to internationalize China's enterprises.

A second restricting factor is intense competition in the international market. It is inevitable that all countries of the world and especially the developed countries will continue to accelerate the internationalization of enterprises in their own countries in pursuit of higher profits and in the struggle for international markets and raising the economic status of their own country. Everyone knows that internationalization of enterprises in a country involves using the differences in economic development levels between it and other countries and imbalances in the technology and management of certain industries to foster its own advantages and relative superiority, move into links and sectors where other countries are relatively weak, and integrate with the favorable conditions there to earn even higher profits. Still, internationalization of enterprises China has been guided by the traditional concept of cheapness and quantity for a long time and the prices of our export products are too low. Moreover, the fact that they are low is not due entirely to the existence of relative advantages. Many internationalized enterprises are not concerned with costs or profits and losses in their management. They purchase raw materials at high prices in China and compete with products at low prices in foreign countries. Engaging in "wool wars", "rabbit fur wars", and so on are prime examples. Doing so earns little foreign exchange, however, and the situation of low economic benefits have made it hard for Chinese enterprises to adapt to the external international environment of ever more intense international competition, and it is a difficult burden to bear given China's financial and economic situation. Since 1979, China has received several tens of anti-dumping accusations from the European Community and the accusations cover a rather wide range of commodities. All of these things have affected the development and opening up of enterprise internationalization in China. As for China's present situation, I feel that internationalized enterprises should bring foreign trade organizations into enterprises and make them an integral part of enterprises. If the two are kept separated and we "scratch an itch from outside one's boot" [attempt an ineffective solution], where will our comparative advantages come from? Alternatively, we can directly entrust internationalized enterprises with foreign trade authority.

A third restricting factor is that the soft social foundation and environment required for enterprise internationalization in China is relatively backward. Despite the urgency of promoting enterprise internationalization at present in China, it would seem that we have the ability in capital, technology, population quality, social mass, enterprise education, and other conditions but lack the determination. A key realm of world competition at present is developing production of high added value products and technical fields with high salary jobs like microelectronics, biotechnology, telecommunications, civil aviation, automated production, working machine tools, computer software, and other realms. Moreover, products in these fields involve very high development expenditures. Based on China's present economic levels, besides that used for normal consumption and other uses, a substantial part of the new value created each year must be set aside for the consumption uses of our newly-added population. Very little is actually used for high S&T capital and the shortages are too great. At Sharp in Japan, for example, Sharp's enterprises have more than 6,000 specialized research personnel, equal to 10 percent of their total personnel, and it invests more than 14 billion yen a year on research. Sharp produced Japan's first transistor radio, first television, first microwave oven, and first liquid crystal display computer. The high research expenditures invested are typical of Sharp and the secret behind Sharp products being sold throughout the world. Furthermore, while Boeing Corporation in the United States and the Airbus Corporation in Europe were competing in the international civil aviation market, Japan was indicating that it will take over 10 percent of the international civil aviation market before the year 2000. If China made substantial investments, it could also quickly take over an even larger portion of the international civil aviation market. The sales volume at Daqing Oilfield, the leader of the China 500, in 1990 was 10.2 billion yuan renminbi. This figure was more than $100 billion in the United States' General Electric Corporation. To move first-rate Chinese products into the international market as quickly as possible and sustain our competitive advantages, it is obvious that we must reduce product design and processing schedules. Achieving this will require larger inputs of manpower resources. What is needed for technology development work is not machine operators who work on production lines every day but instead is several newly trained and intelligent workers and new production technologies.

In the competitive world, competitiveness is the fundamental guarantee for an enterprise's internationalization status. The motive force for developing enterprise internationalization in China requires an excellent competitive external environment. I feel that this should include domestic competition. Everyone knows that Sony's slogan in Japan was resolute defeat of Matsushita, which

was a challenge to Japan's biggest electronics enterprise. It was precisely because all of Japan's enterprises went all-out to achieve prosperity in domestic competition beset with crises that made Japanese enterprises obviously exceptionally powerful on the international commodity economy stage after the best were victorious and the worst were abandoned. We must face squarely the fact that our headache is that China now usually resorts to "whipping fast oxen". Logically, we should commend and support our "fast oxen", "spur slow oxen", "whip lazy oxen", "kill sick oxen", and "abandon unique oxen". This would strengthen the competitiveness of China's enterprises. If our policies continue to implement "whipping fast oxen" for a long time, how will we be able to make the Chinese economy enter a benevolent cycle? Whipping fast oxen makes it hard to stimulate the consciousness of China's enterprises to participate in international competition and makes it hard to improve enterprise quality quickly.

II. Internationalization of China's Enterprises and Modernization of People

The development of enterprise internationalization has its own laws. Internationalization is a comprehensive concept that refers first of all to developing the forces of production to attain international levels and placing enterprises in an unprecedented state of struggling to move forward. This state is not just manifested in material civilization. Even more importantly, it is manifested in the modernization of people. I wrote an article on the modernization of people in 1985. The modernization of people does not simply mean modernization of a certain quality. Instead, it is multifaceted modernization of people's thinking, psychological state, concept of value, and many other areas.

Modernization of people is the key to developing internationalization of China's enterprises. Some 12 years ago, after the curtain of China's opening up to the outside world was opened and the skylight that had been closed for so long was opened and we feasted our eyes on so many beautiful things and were dazzled for a period by the brilliantly colored modern S&T of foreign countries, advanced management technology, advanced technical equipment, instantaneously changing information, and the warm waves of high S&T rolled in like the tide. As time passed, however, people suddenly discovered that like the advanced equipment that was not as efficient here as it should have been, scientific management methods did not invigorate enterprise administration and many high S&T patents became a stack of waste paper. What was actually going on with all of this? Could it be that the advanced equipment was not advanced? Was scientific management not scientific? Did high S&T not conform to China's national conditions?

Standing on the heights looking toward the world, looking toward the 21st Century, and looking toward modernization, it was not hard for people to become aware that an invisible force was interfering and obstructing China's steps toward enterprise internationalization. This force was perceived sometimes in a conscious state, but most of the time it was perceived in an unconscious state. For example, demand in the international commodity economy acknowledges differences, encourages competition, and observes the victory of the superior and abandonment of the inferior. In contrast, many of use were still pursuing the big common pot and egalitarianism, considering this to be perfectly justified. Without a doubt, if this mode of thinking continues, China's enterprises will inevitably suffer a setback in the arena of the international commodity economy stage. Competition among international enterprises depends in the end on competition in the quality of people. Analysis of the sources of economic growth over a relatively long period in the developed nations shows that in the growth of the economy of the United States during the 25-year period from 1948 to 1973, capital factors accounted for only 19.45 percent. In the growth of the economy of West Germany during the 12-year period from 1950 to 1962, capital factors accounted for only 22.48 percent. In the growth of Japan's economy during the 18-year period from 1953 to 1971, capital factors accounted for only 20.99 percent. Thus, the developed nations have shifted their hopes for economic growth from the increases in capital inputs of the past to investments in enterprise employees themselves. Growing numbers of enterprises in the United States are adopting Human Resource Planning. Everyone knows that soil erosion is a threat to agriculture and that loss of value is a threat to enterprises, but both of these types of erosion are nothing more than erosion of skilled personnel. Erosion of skilled personnel is a threat to the economic development of a country. Personnel erosion in England has caused them to slip from a vanguard status in S&T to being a second-class developed country while the skilled personnel attraction policies of the United States have quickly made it the champion in S&T and economic development. This is even more the case in Japan, which has developed its human resources without regard for the cost. As S&T have developed, the operation and maintenance of machinery will become even more difficult and complicated than before and higher demands will be placed on the skills of workers. Competition in the international market is intense and enterprises will place ever-higher demands on market sales personnel, administrative and decision making personnel, new product development personnel, commodity storage and shipment personnel, personnel in the banking and financial specializations, and public relations personnel in order to maintain the competitive advantages of enterprises. Only when all of these personnel maintain high functions and high achievements will enterprises be able to maintain competitive advantages on the international stage.

We easily discover when looking at the present situation for qualified personnel in China's enterprises that there are many weaknesses that are manifested mainly in:

A. Low quality of skilled personnel compared to similar enterprises in foreign countries

The world technological revolution has transformed mankind's reliance purely on consumption of physical effort to earn income so that it now depends even more on intellectual labor. Besides having a solid industrial foundation, enterprises in the developed countries pay extremely close attention to commercial education. Business administration accounts for 25 percent of the total number of college students in the United States and 15 percent in England, but just 1.9 percent in China. For this reason, there are extreme shortages of qualified commercial personnel in the process of internationalizing Chinese enterprises. In the process of connecting up with the international market, we are forced to utilize rather low level personnel and those who have had contact with high-level commercial personnel at the Ph.D. and Master's levels in large enterprises in foreign countries. The result of the contact is often unfavorable for Chinese enterprises and the main danger is the relatively wide disparity in the quality of skilled personnel.

B. A lack of firm policy measures for attracting personnel and reserving personnel

The attraction of skilled personnel from all countries of the world by internationalized enterprises is one way to readjust an enterprise's personnel structure. Relying on enterprises themselves to train qualified personnel easily results in inbreeding of knowledge that does not help enterprises open up international markets and also makes it difficult for enterprises to change their skilled personnel structure. The United States is a latecomer among capitalist countries. The economic invigoration and S&T progress in the United States began after its war for independence, grew up after the war between the north and south, developed after World War II, and gained a vanguard status in the 1960's. This was inseparable from the United States' national policy of attracting and reserving skilled personnel. Japan's emergence also depended on a strategy of personnel development. Thus, I feel that for Chinese enterprises to accelerate internationalization, besides quickly digesting advanced technology imported from foreign countries, they should move quickly to throw off their dependence on foreign technology and innovatively develop "Chinese technology". To achieve this, besides training their own innovative personnel, importing this type of skilled personnel from foreign countries is also an urgent task. We should move quickly to adopt measures to attract Chinese students in foreign countries who have an "international field of view" and allow them to return to China as soon as possible and render service to their motherland to repay its kindness. We should move quickly to find ways to improve the working conditions of skilled personnel inside China who understand foreign trade, foreign languages, and foreign economies and technology and provide them with ample scope for their abilities. We should set our sights on the distance regarding the question of attracting personnel and reserving world-class qualified personnel. If we fail to start now, it will be unthinkably difficult for China to be victorious in world economic competition and S&T competition in the future.

Research on Chinese enterprises cannot be confined to a single country but should instead be internationalized. If our study of China's enterprises holds rigidly to the economic concepts of a single country, there will inevitably be no way to guide China's economy toward internationalization and take our place among the nationalities of the world.

Plans for Small Business Cooperation With Foreign Firms

92FE0401E Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 11 Feb 92 p 4

[Article: "State Draws Plans For Medium and Small Business External Cooperation"]

[Text] The recently formulated plans for medium and small business external cooperation note five problems to be watched when cooperating with foreign traders as follows:

Light Industry: Suitable development for export of small amounts of numerous varieties of well-known premium products that can be delivered quickly to earn foreign exchange.

Textile Industry: Emphasis on solving technological difficulties and fixing weak links.

Machinery and Electronics Industries: Emphasis on increasing product life, precision, and reliability. Items for which cooperation is permitted include heat processing technology, bearings, hydraulic pressure components, and expansion of the application of laser technology to welding, cutting, and surface processing.

Chemical Industry: Priority development of the export of fine chemical industry products for which there are numerous varieties, that can be replaced quickly, for which output is small, and that perform well, and are very useful.

Construction Materials Industry: Emphasis on improving level of technology, greatly lowering energy consumption, and raising output and quality.

Four Bases Being Built To Support Research Institutes

92FE0114E Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese 28 Sep 91 p 1

[Article: "Accelerate Scientific Research Intermediate Testing Base Area Construction, Increase the Might and Reserve Strengths of Scientific Research Academies and Institutes"]

[Text] During 1991, Beijing Municipality has further strengthened scientific research intermediate testing base area construction by building four new intermediate testing base areas that have played an active role in increasing the might and reserve strengths of scientific research academies and institutes under the jurisdiction of Beijing Municipality. According to statistics from 83 academies and institutes under the jurisdiction of Beijing Municipality, their net incomes during the first half of 1991 increased by 6.2 percent over the same period in 1990, investments in scientific research reserve strengths increased by 44 percent over the same period in 1990, and R&D was done on 491 new products, 372 of which have already gone into production, up 51.8 percent over the same period in 1990.

In the past, the shortage of intermediate testing measures and capabilities in these scientific research academies and institutes seriously affected the course of converting S&T achievements into forces of production. To change this situation, the Beijing Municipal Government decided that, starting in 1990, it would allocate special funds over 3 years to support intermediate testing base area construction for scientific research academies and institutes. For this reason, the Beijing Municipality Science and Technology Commission issued its "Opinions Concerning the Establishment of Intermediate Testing Base Areas for Scientific Research Academies and Institutes Under the Jurisdiction of Beijing Municipality" and decided to begin from 1990 to 1992 to build and improve 10 to 15 scientific research intermediate testing base areas. On a foundation of perfecting five scientific research intermediate testing base areas already constructed, Beijing Municipality built another four scientific research intermediate testing base areas during 1991. They are the Beijing Experimental Animal Center's "Biotechnology Drug Intermediate Testing Base Area", the Beijing Municipality Machine Building and Electronics Research Academy's "Precision Numerical Control High-Efficiency Special-Purpose Equipment Research Intermediate Testing Base Area", the Beijing Municipality Plastics Research Institute's "Functional Agricultural Plastic Processing and Molding Technology and Product Intermediate Testing Base Area", and the Beijing Municipality Medical Instruments Research Institute's "Accelerator Radiotherapy Equipment Set Intermediate Testing Base Area".

Five Cities in Shandong Chosen as S&T Pilot Project Points

92FE0401H Shanghai JIEFANG RIBAO in Chinese 19 Feb 92 p 3

[Article by Correspondent Guo Xiusheng [6753 0208 3932]: "State Science and Technology Commission Decides To Establish Pilot Project Zone in Five Cites of Shandong Province To Make Cities Nationwide Prosper Through Science and Technology"]

[Text] The State Science and Technology Commission recently decided to designate Jinan, Zibo, Weifang, Yantai, and Weihai in Shandong Province pilot project cities for making cities prosper through science and technology nationwide, and it approved a plan for going ahead with the Shandong pilot project zone for making cities prosper through science and technology.

The pilot project zone covers a 50,300 square kilometer area containing a population of 26,250,000. It is an area in which industrial and agricultural development has been fairly rapid, and the level of production technology is fairly high. The overall goals of the pilot project are as follows: to use pilot projects in the further advancement of reform and opening to the outside world, the pilot project zone becoming similar to the Zhu Jiang Delta, and the Chang Jiang Delta, and additionally having the distinctive character of a developed area on the Shandong peninsula in the lower reaches of the Huang He; becoming an important "window" through which science and technology and the economy of the whole country can open to the outside world, an important base for earning foreign exchange from exports, an area of concentration of high technology industries, a hub from which sophisticated science and technology is diffused to inland areas, and a multiple experimental zone for deepening reform in gradually taking a road of reliance on scientific and technical progress to run large and medium size enterprises well.

By the end of the Eighth 5-Year Plan, the pilot project zone should meet the advanced or the leading level for major economic and technical standards in China. It should have a rational pattern of scientific and technical capabilities and productivity, presenting a new pattern of basic industries, mainstay industries, newly developing industries and an optimum mix of tertiary industries. In addition, an operating mechanism as well as the framework for a new science and technology system that is in keeping with the laws of development of science and technology and a socialist commodity economy should have begun to be built in which science and the economy work together and promote each other. This will enable a shift to a path of reliance on scientific and technical progress, and a rise in the quality of the work force for economic construction.

Ding Henggao on Product Quality Management, Promoting Productivity Development

92FE0114H Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 9 Oct 91 pp 1-2

[Article by Ding Henggao [0002 5899 7559]: "Reinforce Product Quality Management, Promote Development of Forces of Production"]

[Text] **Editor's note:** National Defense Science, Technology, and Industry Commission chairman Ding Henggao recently wrote an article describing the importance of product quality management and proposed that product quality truly be raised to a new level. Further improvement of the efficacy of weapons and equipment

in war is an urgent task at present. With the agreement of the author, ZHONGGUO DIANZI BAO made some deletions at the time of publication.

Comrade Deng Xiaoping has pointed out that "science and technology are the first forces of production". S&T progress has promoted the development of human society and civilization and created abundant material wealth. The emergence of the new technological revolution will inevitably promote development of the forces of production, and high-quality products are one of the main indicators of development of the forces of production. Product quality management is an extremely important branch of S&T. It can promote improvement in product quality and fully embody the essential role of S&T as the first force of production. Urgent tasks that we face during the 1990's are facing the challenge, using opportunities, establishing a modern "quality concept", reinforcing comprehensive quality management, and truly raising product quality to a new level to improve the efficacy of weapons and equipment in war.

I. The Development of Product Quality Scientific Management During the Course of Industrialization

As human society developed, product quality attracted people's attention very early. [passage omitted] As industry developed and the industrial revolution emerged, specialized product quality inspection personnel appeared and specific organizational forms for inspection took shape. Scientific management of product quality, however, was something that appeared only during the last 100 years. Overall, the development of scientific product quality management can be divided into the quality inspection stage, statistical quality management stage, and comprehensive quality management stage.

The creation of the quality inspection stage promoted improvements in product quality, productivity, and economic benefits. Large-scale production requires control of product defects and consistency, which spurred the entry of scientific management of product quality into the statistical quality management stage. However, the extension and application of statistical quality management in industry occurred during the Second World War. During this stage, active research and extension were done on sample inspection methods and management charts and sample inspection became the two main pillars of statistical quality management technology.

The development of S&T and frequent updating and replacement of industrial products engendered greater complexity in the factors that affect the product quality formation process and many types of large-scale and complex products as well as systems engineering were born. For product quality requirements, the most important were unprecedented improvements in safety and reliability requirements. As a result, relying purely on statistical analysis during the production process to carry out quality control no longer enabled comprehensive analysis and evaluation to determine whether or not products attained high quality. This required the adoption of powerful measures to probe into the essential defects within parts and components, to study the physical and chemical mechanisms of product failure, and even carrying out microscopic analysis measures to describe the reasons for failure in order to make product improvements on this foundation. In another area, regular testing methods could no longer be used for assessment or inspection and appraisal of product quality by using a few products within a short period of time. Thus, beginning in the 1960's, as S&T developed, breakdown physics and production quality control were closely integrated. Moreover, with new developments in management science, there was prominent "attention to human factors" and "protecting the interests of consumers" as well as the emergence of boycotts of plants and institutions that manufactured and sold poor quality consumer goods, intensified market competition, and so on that required enterprises to assume responsibility for guaranteeing the quality of products. At the same time, the development of systems enterprise management technology and reliability and maintainability technology as well as the maturation of engineering analysis and testing methods provided scientific measures for quality guarantees in the product development process. As a result, A. V. Feigenbaum in the United States proposed the concept of comprehensive quality management in the early 1960's, which marked the entry into the comprehensive quality management stage.

The proposal and development of comprehensive quality management explains its scientific properties in scholarly terms, in internal structure, and in practice. With the continual development of S&T, and in particular the appearance of large complex weapons systems, in addition to products having excellent properties, they must also satisfy reliability, maintainability, safety, and other requirements. At the same time, the economy of products also destroyed the simple concept of the cost of the manufacturing process and required consideration of the cost of the entire lifespan cycle, including the entire development and utilization process. As a result, people's concepts of product quality and quality management were also quickly developed and updated. Thus, the new stage of "comprehensive quality management" that is now being extended worldwide was formed.

One can see from the development process of scientific management of product quality that there have been continual changes in the temporal and spatial concept of quality management and continual developments in its depth, breadth, and processes. Strengthening quality management and improving product quality are very important in the new technological revolution. In national defense S&T, we are now developing advanced S&T, developing new technological realms, and broadly applying information technology, computer technology, automatic control technology, remote measurement, remote sensing, and remote control technology, precision processing technology, and many other types of unique techniques, materials, and testing technologies.

The advanced qualities, complexity, and interrelationships of these technologies determine that they place high requirements on quality. Moreover, the harshness of the environment in which military industry products are used and the considerable expensive involved to develop and guarantee them determines that there will be strict requirements for their quality.

In summary, high technology requires high quality. In contrast, high quality also promotes the development of high technology. Implementation of comprehensive quality management is essential for achieving the requirements of high quality. This is also an important guarantee for achieving "success on the first try" in product development. Reinforcing comprehensive quality management also substantially shortens technical product development schedules and conserves development and utilization costs. It can be said that high quality is an objective law that high-S&T development must follow.

For military industry products, the importance of improved product quality is: 1) Quality has become one of the important nuclei of military technology and industry competition and the essence of market competition has already begun shifting from price competition to product efficacy/cost ratios (the ratio of a product's efficacy to its cost over its entire lifespan). To strengthen the competitiveness of our national defense S&T industry (including the market competitiveness of civilian products after a shift from military to civilian production), we must certainly focus on quality. 2) The comprehensive quality of military industry products includes the totality of performance, reliability, maintainability, safety, economy, and other attributes and characteristics. 3) Only by fully fostering the functional role of quality guarantee departments for all links and improving product quality on the basis of improving work quality to increase the efficacy/cost ratio can we achieve low costs, high efficiency, and high benefits and make enterprises move into benevolent cycles. Quality is not only a requirement for the existence and development of enterprises themselves. It is also an objective requirement for developing social forces of production and improving economic benefits. Quality is the nucleus and foundation of benefits. The huge sums invested in important models in the military industry require that risks be reduced to a minimum and must ensure success on the first try.

We must acknowledge that quality is the lifeblood of military industry products and military industry enterprises and establish the concept of "quality first for military industry products". From the perspective of "S&T are the first force of production" and "quality first", we must resolutely take the path of using S&T to strengthen our military and quality to build our military.

II. Establish a Modern Concept of Quality and a New Concept of Comprehensive Quality Management

Quality refers to the appropriateness of a product and is a natural property that a product must have to meet a demand. Appropriateness refers to the degree to which a product can successfully meet the requirements of users when it is used. In other words, product quality is the total attributes and characteristics that enable a product to satisfy a specific demand. These attributes and characteristics include the sum of the performance, reliability, maintainability, safety, economy, and other properties of a product.

The traditional concept of quality only stresses that products "conform to stipulated requirements". Products that merely conform to production blueprints and technical stipulations are products that meet quality specifications. The new concept of quality stresses that "products conform to requirements correctly stipulated to meet users needs". Here, the attention is on conformity to requirements as well as an emphasis on product suitability and product appropriateness, including the appropriateness of product functions (the advanced nature of product technical performance), appropriateness in use (safety, reliability, convenience of product use and maintenance, etc.) and marketing appropriateness (products are delivered on schedule and good after-sales services are provided). Simply stated, the modern concept of quality is concerned with the basic concepts of a product's "long-term maintenance of excellent functioning" and "optimum full-lifespan cycle costs", meaning that a product should have excellent functions and relatively low full-lifespan costs.

The transition from the traditional concept of quality to the modern concept of quality is manifested primarily in:

1. A shift from the simple pursuit of performance to a concern for efficacy (long-term maintenance of excellent functioning);

2. A shift from lowest purchase cost to optimum full-lifespan costs;

3. A shift in guiding ideology from correction of defects to prevention of defects and a focus on prevention;

4. A shift from "inspection" measures to guarantee products to the injection of quality into the design and manufacturing processes to provide comprehensive guarantees in the product;

5. A shift from an emphasis on costs and progress to an emphasis on a comprehensive balance of quality, cost, and progress.

Corresponding to the modern concept of quality is modern quality management, meaning comprehensive quality management. Comprehensive quality management has a complete set of management theories as well as a complete set of management principles and methods. Guided by theory, quantitative and qualitative methods are used to mobilize every member in an organization for joint efforts to make continual improvements in the quality of products (or services) at every link and increase the extent to which users' requirements

are met. The emphasis in comprehensive quality management is on full-process, omnidirectional, full-staff quality management. 1) Comprehensive quality management must carry out quality management throughout the entire process of product development, production, and utilization, meaning project establishment, design, trial manufacture, testing, model determination, production, and the full lifespan of utilization. Statistics show that because the economic losses arising from quality defects at different stages of development increase with changes in the number of defects, the earlier that quality defects are revealed and corrected, the smaller the losses suffered. This is particularly true for the discovery of defects at the initial design stage, which can greatly reduce losses. It must be understood that the absence of quality management in the design stage is the most important cause for poor design. Product quality is not achieved at final inspection but is instead achieved in design and manufacture. We should adhere to the principles of combining design quality and manufacturing quality and combining product quality and service quality, extend quality management in both directions, and change over to quality management of the entire product development, production, and utilization process. 2) Comprehensive quality management must carry out omnidirectional quality management of a product's performance, reliability, maintainability, safety, economy, and so on. The concept and methods of comprehensive quality management do not just penetrate the functional design process and production process. They must also permeate reliability, maintainability, safety, and other technical realms. Quality engineering involves complex systems engineering and organizational management must be carried out according to the ideology of systems engineering. 3) Comprehensive quality management requires all personnel to concentrate their attention on continually improving product quality. It must be stressed that leadership is the key in extending comprehensive quality management into the military industry. Only when leaders in all enterprise units are concerned with quality can they lead all personnel and workers and effectively undertake comprehensive quality management, which has "full staffs" as one important characteristic. It should be stressed throughout the military industry that focusing on product quality work is a joint task of all personnel in enterprises and institutions and not just the responsibility of quality management departments. All members of enterprises and institutions should have a good concept of quality, actively study and grasp the new technology of quality systems engineering, and assume responsibility for quality. 4) Comprehensive quality management must first of all place quality in the primary position. "Quality first, always first" was the main topic of the Seventh International Quality Conference in 1987 and it is being acknowledged by increasing numbers of countries. This is extremely important for the national defense S&T industry system and is an eternal concern for every enterprise and the entire military industry.

III. Strive To Raise Product Quality Up Onto a New Stage

At present, the most urgent task facing national defense S&T and the military industry is raising weapons and equipment development and production up onto a new stage based on the requirements of "the modern concept of quality" and the new stage of "comprehensive quality management" to meet the needs of high S&T development and face the challenge of the new technological revolution. Practice in modern warfare has shown that in the technological realm, the performance of weapons and equipment can only be truly fostered if they are highly reliable. To improve the quality of China's weapons and equipment, not only must we further improve performance, but even more important is that we also make improvements in reliability and maintainability.

1. Transform concepts, strengthen our understanding of quality. Under the guidance of the modern concept of quality, we should focus at present on dealing with the dialectical relationships between speed and benefits and between understandings of quantity and quality. The report of the 13th CPC Central Committee pointed out that "we must resolutely and unwaveringly implement the strategy of a concern for results, improved quality, coordinated development, and stable growth. The basic requirements of this strategy are efforts to improve product quality, concern for appropriate sales avenues for products, reduced material consumption and labor consumption, and the achievement of rational deployments of the factors of production....in the final analysis, this means a transition from extensive administration as the primary factor to the track of intensive administration as the primary factor." Only by truly achieving high product quality along with appropriate sales avenues can enterprises improve economic benefits. One of the main causes of stagnant sales and overstocks of products as well as low benefits in many enterprises is poor quality. Thus, military industry enterprises must resolutely take the development path of quality and results and make them an extremely important guiding principle in their economic work and resolutely adhere to them in the long term. They should make maintaining and improving product quality a major affair in the life or death of enterprises from beginning to end and cannot lower their guard at any time.

2. Begin at top levels and at the head, develop gradually. The "Military Industry Product Quality Management Regulations" clearly stipulate that in enterprises and institutions, administrative officials (plant managers and institute directors) have comprehensive responsibility for quality work in their unit. Quality assurance organizations have administrative authority under the leadership of plant managers and institute directors. This provision embodies the ideology of a single person focusing on quality and having responsibility for quality in comprehensive quality management. Only when leaders establish a powerful understanding of quality can they truly implement the principle of quality first. In

model development work, the model commander has responsibility for comprehensive quality management and the designer system has responsibility for project development quality. Besides the leaders of their units having responsibility for completing their duties, the senior quality official or persons with responsibility for the project in quality assurance organizations should be responsible for project quality supervision, inspection, control, management, and other related work. The model commander, senior designer, and senior quality official should follow the principle "quality first", support each other, jointly focus on the quality of model development, and ensure "success on the first try" for model development. During the development process, the quality ideology and requirement of "success on the first try" should penetrate the entire stage and implement the ideology from the beginning. Especially important are the need to focus on continual improvement of product design quality and major attempts to eliminate hidden product defects during the design process.

3. Reinforce full-lifespan cycle quality management, strive to raise product quality up to a new stage. Quality management throughout the entire lifespan of a system is an important part of full weapons system management. We should reinforce comprehensive quality management throughout the entire lifespan of a model from discussion and project establishment to design, trial manufacture, testing, model determination, production, and utilization. We must focus on improving equipment efficacy and reduce full-lifespan costs as a core issue in improving quality. While improving efficacy, we must also be concerned with additional comprehensive assessment and analysis of equipment (product) efficacy and costs so that while we are achieving higher efficacy we are also reducing full-lifespan costs. In the future, in comprehensive discussions, strategic technology indicators, development programs, and development task documents for new models, there must be rational reliability and maintainability indicators or they should not be approved. After the reliability and maintainability indicators in each stage are examined and meet specifications, they can enter the following stage of work. The "modern concept of quality" and the new stage of comprehensive quality management pose higher requirements for weapons and equipment research, testing, production, and utilization departments and the idea of comprehensive quality management for the full-lifespan process of products is an indication that the guiding ideology in quality management has shifted from "after the fact" to "focusing on prevention" and "success on the first try", and we should strive to achieve this historical transition.

In strengthening the product comprehensive quality management process, we should also focus on doing the corresponding basic work well.

There should be plans to reinforce advance research and developments in technical, materials, testing, and analysis technology. In particular, improvement of personnel quality and improvement of management levels should be placed in an important status.

Research Work in Institutions of Higher Learning Making Advances

92FE0417F Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 28 Jan 92 p 2

[Article by Yang Dongzhan [2799 2639 0594] "Research Work in Institutions of Higher Education Moves Ahead Steadily. Research Work in Institutions of Higher Education Faces New Circumstances and New Tasks at the Turn of the Century. Need to Make Full and Effective Use of the Multiple Advantages of Institutions of Higher Education To Advance Their Research Work Across-the-Board in a Step-by-Step, Accentuated Way"]

[Text] During the past 10 years of reform and opening to the outside world, particularly during the Seventh 5-Year Plan, research work in institutions of higher education developed rapidly, scoring outstanding accomplishments both in orienting toward the main battleground of economic construction, and in every level of scientific and technical work.

Current Status and Achievements of Research Work in Institutions of Higher Education

(1) **Marked Increase in Scientific Research Forces.** The science and technology corps numbers 589,000 people today, 492,000 of whom are scientists and engineers, up 22.8 and 38.7 percent respectively from 1985. This converts to 126,000 full-time personnel in a 41.4 percent increase over 1985. Outlays for research total 1.396 billion yuan, including 387 million within budget, and 1.009 billion outside budget. This is a respective 127.3, 44.7, and 183.7 percent increase. Research and development topics (in physics, engineering, agriculture, and medicine) number 80,189 for which expenses of 1.148 billion yuan have been disbursed. This is 55.5 percent more development projects and 109.7 percent more money than in 1985. During the Seventh 5-Year Plan, institutions of higher education gathered 115 national awards in the natural sciences, 284 awards for inventions, and 506 scientific and technical progress awards. This was 48.1, 33.8, and 21.8 percent of the total number of awards for the whole country. A total of 37,208 projects have been authenticated, evaluated and examined preliminary to acceptance, and 26,734 technology transfer contracts have been signed. Research organizations in institutions of higher education now number 1,666, There are 42 key national research laboratories, and more than 500 key branches of learning have been established. This reflects in an overall way the great strength of research in institutions of higher education.

(2) **Outstanding Accomplishments From Orientation Toward the Main Battleground.** Colleges and universities are working either independently or in partnership on more than 3,400 key national scientific and technical projects for which expenditures total more than 440

million yuan. This includes National Education Commission sponsored projects on "development of low temperature heat supply technology," "development and application of laser technology," and "research on new materials." Outstanding advances have been made on all these projects, and they are beginning to be industrialized. At the same time, a large number of key projects have been completed in the agricultural, energy, communications, petroleum, and biological fields. Institutions of higher education are taking active part in work entailing the use of science and technology to make agriculture prosper. During the Seventh 5-Year Plan they completed nearly 10,000 agricultural science and technology projects, more than 3,000 of which have been applied to agricultural production in varying degrees. During that 5 year period, economic returns totaled approximately 62 billion yuan. Eighty-five achievements of institutions of higher education were included in the national level key promotion plans that were first put into effect in 1990. They included "bacteria for increasing crop yields," "new type air-cooled bainite steel," and such achievements that will likely be of extreme economic and social benefit. Another 65 achievements were made a part of national important new products trial production plans.

(3) Development by Leaps and Bounds of High Technology and Industrialization. In the five civilian fields for which the National Science and Technology Commission is responsible in the "863" Plan, institutions of higher education are participating in 97 special topics and 502 special sub-topics in all 11 main fields, This is 54 percent of the total number of topics. In the fields of biotechnology, automation technology, energy technology, and laser technology, they have produced a number of research results at the international advanced level, and a large number of young leaders in high technology studies have also come to the fore. During the past 3 years, a total of 122 research results from institutions of higher education have been made a part of Torch Plans. This is 12.6 percent of the total number. As of 1990, 183 enterprises moved into development zones where they produced a gross output value of 2.348 billion yuan, and exports totaling 462 million yuan. Scientific and technical enterprises that institutions of higher education operate themselves are mostly high technology industries. In 1990, the number totaled 253 producing an output value of 550 million yuan and making an annual profit of 110 million yuan.

(4) Advantages From Basic Research Further Exploited. During the Seventh 5-Year Plan, national natural science fund projects totaled 65 percent of all research projects underway in institutions of higher education, and 62 percent of all expenditures went for them, showing the great strength of institutions of higher education in basic research.

Circumstances and Tasks That Research Work at Institutions of Higher Education Face

The 1990's were an important period for development of China's economy and society, and this was also a period of most intense competition in the world. Competition of overall national strength is, in the final analysis, scientific and technical competition, and competition in human talent. At the turn of the century, the scientific and technical work of institutions of higher education faces new situations and new tasks foremost of which are the following:

(1) Lack of Funds For Scientific Research. Basic research, applied research, developmental research, and industrialization of scientific and technical achievements all face a serious lack of funds.

(2) Slow Progress in the Spread of Scientific and Technical Achievements. The lack of am experimental interface, the low rate at which research matures, the lack of ability to link all parts into a whole, and the numerous impediments to industrialization of results seriously impair the work of translating research into products. Acceleration of this transformation is a longer-term and daunting task.

(3) Unfavorable Climate For Linking Production and Study. Forging numerous links with enterprises is an important orientation in the scientific and technical work of institutions of higher education. The lack of impetus toward technical progress in enterprises, the increase in their short-term behavior, their weak conception of the value of technology as a commodity, and their not very great interest in accepting university and college participation in technological progress puts a very great damper on the enthusiasm of scientific and technical personnel in institutions of higher education.

(4)No Large Steps Taken in the Industrialization of High Technology. The 1990's were a golden age for high technology industries. This period posed both opportunities and challenges for institutions of higher education. Institutions of higher education enjoy advantages in being knowledge-intensive, in the availability of information, and in the gathering of human talent. They are in a good position to become a nucleus for developing high technology industry. However, the lack of policy preference makes it hard to get institutions of higher education to adopt plans for inclining toward, nurturing, guiding, and encouraging high technology industry. Institutions of higher education maintain a wait-and-see attitude about development zones. Without doubt, this results in irretrievable losses to the country in the development of high technology industry. Numerous problems are awaiting solution today in the macro-policy realm and the social environment, as well as within schools.

(5) Lack of Continuity in the Science and Technology Corps; a Markedly Irrational Personnel Structure. Basic theoretical research, the training up of skilled personnel, the development of science and technology, and the

industrialization of science and technology are all impossible without scientific and technical personnel, particularly young scientific and technical personnel possessed of a pioneering spirit. The unabated increase in shock waves from the "craze to get out of China," and the "craze to do business" that stems from the social climate and external conditions, plus problems in employment, housing, and income seriously impair the continuity of young scientific and technical personnel. Academic leaders are relatively old; the composition of the research corps is irrational; the impetus to leave China cannot be halted within a short period of time; and the problem of a shortfall between the retirement of old hands before young hands are ready to take their place—problems which are becoming becoming more pronounced—present yet another grim situation for institutions of higher education in their scientific and technical work.

(6) **System Reform Remains an Extremely Daunting Task.** The walls that departments have erected around themselves are hard to demolish; a climate of fair competition is difficult to form; and clearing the way to get things done is difficult. Consequently, colleges and universities find it difficult to commit themselves to various plans in the country and to undertake tasks at various levels. They cannot effectively perform their role as a front line army. The situation is grim in economic work in China today. The trend toward decline in returns has yet to be reversed; financial difficulties have increased; and irrational elements in the economic structure have increased markedly.

Basic Avenues of Thinking and Ideas About Moving Ahead With Scientific Research Work in Institutions of Higher Education

The 1990's is an important period for institutions of higher education development of scientific and technical work. During this period they should have a sense of responsibility and urgency. Their basic line of thinking should be: to use reform to promote the common good, fully and effectively make the most of all the advantages that institutions of higher learning enjoy, widen their social service functions, actively commit themselves to the battlefield, meet the needs of society at many levels and in many ways, accelerate the promotion and translation into products of scientific and technical research achievements, provide impetus to the socialization process of high- and new-technology industries, and bring about a benign cycle in education, scientific research, and production, taking development of the economy, society, and culture as a fundamental goal, and moving ahead across-the-board with scientific and technical work in a step-by-step, accentuated way.

(1) **Orientation Toward the Main Battle Ground of Economic Construction, Actively Taking Part in All National Development Plans** Institutions of higher learning must use their own advantages as a starting point, and take the main battlefield as their orientation for participation in various plans in many different ways. They must conscientiously summarize experiences in tackling science and technology problems during the Seventh 5-Year Plan, wage protracted war, act in terms of the tradition of tackling key problems, and strive during the Eighth 5-Year Plan to make a number of accomplishments at the internationally advanced level on principal energy, and new materials projects. They should also try to train up talent in some fields that are not of outstanding importance for the gradual shaping of a powerful contingent. They should set the stage for the commercialization and industrialization of more of the achievements made in tackling key problems.

(2) **Active Work on Science and Technology to Make Agriculture Prosper.** Institutions of higher education, particularly agricultural colleges, hold an advantage in the development of agricultural science and technology. They must closely link their work in science and technology with "Torch Plans" "Prairie Fire Plans" and "bumper harvest plans," and seize advantages and highlight key points in an effort to make research results that require little investment, that produce quick results, that bring high returns, and that can be spread easily into key projects that create benefits of scale. A science and technology promotion corps having a rational composition and a suitable size must be organized, preferential policies drawn up, and the broad masses of teachers encouraged to go into the front lines of agriculture to make a new contribution to the development of the country's rural economy.

(3) **Constant Joining of Production and Learning To Accelerate Promotion of the Fruits of Scientific and Technical Research.** The old ideas that emphasize theoretical research but slight the translation of the fruits of research into production must be completely rooted out, awareness about spreading the fruits of research increased, and ability to integrate the provision of technical services with technology improved in order to solve the problems of only a small number of research results reaching fruition, and the huge gap in the number than are translated into production, thereby ensuring rise in the rate of spread and translation into production. Schools must do more promotion work, insuring availability of personnel, financial and material resources for a strengthening of intermediate links for trying out technologies. They must forge links with large and medium size enterprises, and concern themselves with matters of concern to business enterprises, helping them dispel their worries and solve their difficulties. They must sincerely serve enterprises. A number of large and medium size enterprises should be selected to serve as science and technology work bases, thereby setting the stage for concerted cooperation. They must build enduring and stable cooperative relationships in which each party has confidence in the other as a means of making contributions to enterprises' technological progress and of improving the ability of institutions of higher education to orient toward realities.

(4) **Active Launching of High Technology Research, and Moving Ahead With Industrialization.** Institutions of higher education must make the most of the multiple advantages they possess in their own academic fields,

take a leading aim and select a proper direction for the active launching of scientific and technical research. They must strive for some leading edge achievements in the fields of biotechnology, laser technology, and energy technology. Schools must plan actively, organize painstakingly, and concentrate their strength to ensure smooth progress in research work. They must take active part in the building of development zones, developing the country's high technology industries in an organized, step-by-step way through various ways and means.

(5) **Active and Steady Development of School-Run Science and Technology Industries.** Schools should select high technology research achievements that require little investment, produce high added value, and show quick results, themselves running science and technology enterprises as a major way for institutions of higher education to develop high technology industry. They must do overall planning, decide what they will emphasize, and concentrate their strength on the operation of school-run science and technology industries. The principle must be to do what the school is best able to do, avoiding rushing into precipitate action at all costs.

(6) **A Complete Policy System Must Be Built With All Possible Speed.** Policies are like running water; they have the power to propel. Full use must be made of the driving, directing, and guiding role of policies. Preferential policies must be used in the industrial, commercial, tax, government finance, and credit realms, and the rights and interests of institutions of higher education must be safeguarded so that more institutions of higher education will devote themselves to the building of the economy. At the same time, impediments in the management system, and hindrances in the microclimate must be removed.

(7) **Serious Attention to the Building of a Science and Technology Corps.** The high technology work of institutions of higher education is done in conjunction with the education of people. Practical and feasible policies must be drawn up; criteria must be set for professional positions; people must be given a free hand in their profession; and priority attention must be given to housing to create all possible conditions that enable a number of talented middle aged and young scientific and technical people to emerge.

Ability to solve the problem of talented scientific and technical personnel in institutions of higher education to train up more highly talented people will have a direct bearing on the future scientific and technical work of institutions of higher education, and will generate a strategic influence on the coming century.

Gao Lulin on Steps to Protect Intellectual Property Rights System

92FE0417B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 20 Feb 92 p 1

[Article by Correspondent Xie Ning [6200 1337]: Major Steps to Perfect the Intellectual Property Rights System. Gao Lulin [7559 4151 7792] Discusses Revision of China's Patent Code"]

[Text] China's Patent Bureau director, Gao Lulin, disclosed at a recent press conference on China's protection of intellectual property rights that China is considering revision of its patent laws, and has begun the task of revising the patent code. This is a matter of great importance for intellectual property owners in China, and it marks a major step in the Chinese government's perfection of the intellectual property rights system. A few days ago the correspondent asked Gao Lulin to discuss some thoughts on various problems relating to patent code revision.

Gao Lulin said that practice in implementation of the patent code during the past 6 years has shown that, in an overall sense, China's patent code is both suited to China's circumstances and also respects international treaties, as well as customary international practice. However, since this is China's first patent code, and since China had no experience with implementation of a patent system at the time of its formulation, the patent code is not the acme of perfection. With the intensification of reform in China and enlargement of the opening to the outside world, timely revision of the patent code is needed in order to create a better social and legal climate. Both the NPC standing Committee and the State Council have made revision of the patent code a part of work plans for the near future. In preparing for investigation, study, and revision of the patent code, the Chinese Patent Bureau set up a patent code revision team in early 1988, which began to consider revision of the patent code. China's legislative procedures require that the Chinese Patent Bureau first present a draft revision of the patent code to the State Council. After the State Council examines and approves it, it is presented to the NPC Standing Committee for deliberation. Currently, patent law revision is in the final stage of the Chinese Patent Bureau's preparation of views.

Gao Lulin told the correspondent that the Chinese Patent Bureau will consider extending the patent rights period for inventions. China's present patent code provides a 15-year patent protection period for inventions, effective from the date of application. However, because inventions in certain fields of technology, such as pharmaceuticals and chemicals, usually have to go through trial, registration, and evaluation procedures that the agencies concerned prescribe during the process of development, manufacture, and marketing, frequently several years is taken up or the protection period may even be exceeded between patent approval until formal permission for market sales is granted. In view of the need for international coordination of the patent code, the period of patent protection for inventions should run for at least 20 years from the date of application. In view of the country's short-term and long-term interests, plans call for extending the patent protection period for inventions from 15 to 20 years when the patent code is revised. This will help encourage interest in inventions and creations in China for which the period of research and development is fairly long, and it will improve scientific and technical levels in these fields.

With regard to patent rights on the invention of methods, Gao Lulin said that China's current patent code prescribes that patents on methods are limited only to the right to prohibit other persons from using a method without permission, but it does not extend to products manufactured from the direct application of that method. This is detrimental to efforts to stir people's interest in inventions and creations to improve technology and methods. Therefore, consideration of revisions to the patent code will emphasize the protection of patent rights for methods, protection of patent rights on methods being extended to the product manufactured through the direct application of those methods. This means that anyone who uses the method without permission may not only not have production and sale as a goal, but also may not use or sell products that directly depend on the method. This is also necessary for international coordination of the patent code, and it is the prevailing practice in numerous countries.

In answer to the correspondent's question about what is being considered in the way of patent protection for chemicals and pharmaceuticals, Gao Lulin said that China has placed patent protection for chemicals and pharmaceuticals on the agenda. This is because developments suggest that expansion of the sphere of patent protection is a general trend among those in the same industries internationally. Unless these fields are accorded patent protection, many problems will occur in bilateral and multilateral scientific, technical, and trade cooperation, and the business concerns concerned will have to rely on imitation of the products of others to survive. This would be detrimental to the formation of an innovation mechanism. For the sake of better reform and opening to the outside world, and in order to incline toward the methods generally used internationally for the protection of intellectual property rights, the Chinese Patent Bureau has decided to adopt a more positive attitude. It is seeking to have the NPC Standing Committee discuss and approve patent protection for chemicals and pharmaceuticals effective 1 November 1993.

In discussing patent code revision and in considering regulations to increase patent holders' authority over imports that may infring their patents, Gao Lulin believes that although China's patent code does not explicitly prescribe patent rights, including patent holders' authority over imports, actually such rights are expressed by conferring sole sale rights on the patent holder. In order to clarify more fully the intent of patent rights, plans call for clarification of the authority that a patent confers during the current patent code revision, including patent holders' rights regarding imports. This means recognition that the holder of patent rights has authority regarding imports. He has authority to demand that the Customs prohibit the importation of products identical to the product for which he holds a patent. On the basis of evidence that the holder of the patent provides, the Customs can impound such patented products. In order to allay the fears of foreign patent holders, whatever rights China accords patent holders will be fully protected. This is also in keeping with international practice.

Gao Lulin added that consideration should also be given to the appropriate revision of procedures concerned and some other imperfections in China's existing patents, mostly including the following: revision of procedures for objecting before a patent is conferred in a change to administrative recession procedures after a patent is conferred, setting up more preferential systems in China, etc.

Gao Lulin emphasized that in terms of the overall picture of reform and opening to the outside world, in terms of protecting China's fundamental interests, in terms of the long range view for development of China's science and technology, foreign economic relations, and trade, the foregoing patent revisions generally benefit China. The negative effect or limitations that they may cause are partial and temporary. In short, in weighing the advantages against the disadvantages, the advantages win. China's decision to make major revisions to its patent code when it has had a patent system for less than 10 years so that the country's level of patent protection is substantially the same as that of developed industrial nations shows China's determination to increase the protection of intellectual property rights is great.

State Patent Bureau Formulates Patent Guidelines for 1990's

92FE0401F Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 25 Feb 92 p 4

[Article: "State Patent Bureau Formulates Patent Work Guidelines"]

[Text] The basic situation existing in the country's patent work today is as follows: The understanding of the whole Party and the whole country that science and technology are of primary importance in productivity has gradually increased, and has been translated into actual actions for advancing the development of science and technology, and moving ahead to link the economy closely with science and technology. This provides a fine opportunity for bringing the role of patent work further into play. It frees to the full the productivity created by science and technology, and the reform of the science and technology system that is currently underway will continue to intensify, gradually becoming a management system and an operating mechanism that will help scientific and technical progress. Additionally, as the scientific and technical revolution spreads all over the world, as international economic, scientific and technical, and trade links grow increasingly close, and as the role in the international economy, science and technology, and trade of intellectual property rights, including patents, becomes more prominent, higher demands will be placed on the development of patent work in China.

In view of the new situation that patent work in China faces, the State Patent Bureau proceeded from the realities of patent work to identify guidelines for patent work in China during the 1990's.

First is to put into effect the basic guiding thought that the purpose of patent work is to serve scientific and technical progress and development of the national economy, to be in keeping with the need to intensify reform and widening the opening to the outside world, to coordinate relations with scientific and technical and economic management systems concerned, to be consistent with the trend of development of the patent system internationally, and to use to the full the role of the patent system in realizing the strategic goal of China's modernization.

Second is the building of a distinctively Chinese patent system, and full expression of its basic features as follows:

1. Proceed from the reality that China's productivity is unevenly developed, and the overall level of its science and technology is fairly backward to arouse widespread interest in invention and creativity that satisfies needs for different levels and different types of invention and creativity in society, providing protection for varying periods of time for inventions, applications to new forms, and external designs.

2. Since China has an economic pattern in which the public ownership system is dominant and many different ownership systems co-exist, and in which the operating autonomy of units under the ownership of the whole people has been expanded, the principle of separation of ownership rights and operating rights is to be practiced, the relationship between the owner and the holder of patents correctly distinguished and handled in order to stimulate interest in invention and creativity on the part of units under different systems of ownership.

3. In order to stimulate the interest of inventors in correct handling of benefits accruing to the state, collectives, and individuals from inventions and creativity, inventions stemming from official employment are to be distinguished in law from inventions not stemming from official employment, and the awards and remuneration for inventions and creations stemming from official employment are to be clearly set. Like encouragement is to be given to inventions and creativity not stemming from official employment, and all legal rights for such inventions and creativity are to be protected in accordance with the law.

4. In view of the needs of the economic operating mechanism in which the socialist planned economy and market regulation are linked, the application of proprietary technology correspondingly promotes the use of methods for linking plan management with market regulation. Since the three kinds of patents for inventions, applications to new forms, and external designs differ in degree and cover a wide range, the application of proprietary technology must rely more on market regulation.

5. Since China is a vast land and is unevenly developed, full use must be made of the role of administration and management, patent control agencies, including patent control organs, being established in different jurisdictions and sectors. In addition to their control function, patent control organs are also to mediate patent disputes according to law.

Wartime Scenario Looks At Threat to Population Posed by a Destroyed Three Gorges Dam

[Article by Di Jianrong [3695 1696 2837]: "A Study of the Civil Defense Issue"

92FE0401I Shanghai JIEFANG RIBAO in Chinese 22 Feb 92 p 3

[Text] The contemporary international climate requires that we take warfare into account when building major projects. The Three Gorges project is an exceptionally large project, and it is also a special project for the impounding of tens of billions of cubic meters of flood waters. This is all the more reason for earnestly taking warfare into account and adopting effective defensive measures.

In the course of interviews, the correspondent learned that both the Party and government are very much aware of civil defense issues involved in building the Three Gorges project. Back in 1958 when the Three Gorges project was first put on the agenda, Premier Zhou Enlai stated explicitly the need to assemble forces from all quarters throughout the country to conduct a study.

The Three Gorges project civil defense study focused on what would happen should a large dam be attacked and destroyed in modern warfare, and what could be done about it. Using all tested principles, the government water conservancy sector built a large scale breached dam model in Hubei. The model measured more than 730 meters in length and covered an area of more than 14,000 square meters. It simulated an actual 366 kilometer long river bed. The researchers spent 6 years during which they conducted more than 200 experiments from which important findings were gained.

One finding was that the Three Gorges Reservoir is a classic river bed type reservoir approximately 600 kilometers long and averaging 1,100 meters in width. The 170 kilometer long river bed from the dam site to Fengjie has a surface width of approximately 500 meters; however, in many places the gorge is less than 300 meters wide. In the outlet section from the foot of the dam to Nanjinguan lies a twisting gorge more than 20 kilometers long. Following a breach of the high dam, although the maximum volume of flow would become greater than 1 million cubic meters per second within the twinkling of an eye, by the time it reached Nanjinguan, it would have diminished more than 85 percent. Obstructed by the

numerous gorges, it would take 3 to 4 days for the entire reservoir to empty. Thus, the flood damage caused by the rupturing of a river bed type reservoir would be less than from a lake type reservoir.

The second finding was that from the point where the Chang Jiang leaves the gorges to below Zhicheng in Hubei, the river widens allowing the river bed to release a large volume of water. The sandbars and river islets in the Minyuan and Jing Jiang flood diversion area impound a large volume of flood water. Flooding from breached dams produce a high wall of water traveling at a fast rate of speed. It rushes along in a torrent, its destructive force in areas just below the dam becoming more powerful than natural flood waters. However, total volume is less than from a natural flood. Specifically, the emptying process is fairly long so the area of destruction is fairly small. Tests were conducted using a non-flood season reservoir water level of 160 meters (26.2 billion cubic meters of water in the reservoir), and a flood season reservoir water level of 145 meters (17.2 billion cubic meters of water in the reservoir). [Figures as published] The results showed that the area affected by the flood waters from the breached dam could be limited within the sand bar and islet area of the Jing Jiang in Hubei Province. It would not affect Shashi City and the north bank of the Jing Jiang or downstream areas. Hunan would be largely unaffected. The flood damage area would be approximately 4 percent the 1954 flood damage area.

Finding number three was that a lowering of the water level in the reservoir during wartime was the most effective way of reducing the possibility of disaster. The consequences of a 175 meter dam breech would be extremely serious. However, the design and construction of the Three Gorges Project high dam would allow sufficient space for the draining of flood waters. Only 7 days would be required to reduce the reservoir's full water depth of 175 meters to 145 meters. At 145 meters, the projects would still be able to operate effectively, and under emergency conditions, the water level could be reduced to around 130 meters.

Would there be sufficiently early warning to lower the water level in wartime? Experts maintain that during the conventional warfare of the past surprise attacks were commonplace, but that matters would not be that simple during a nuclear war. Therefore, during wartime, there would be sufficient time to lower the water level.

The expert validation team believes that the design principles for the breached dam model are correct and that the trials were conducted properly, so the test findings are credible. The conclusion is that since indications of preparations exist in modern warfare, early warning permitting the release of water is possible. Were the dam to be breached in a nuclear attack, only in part of the area from the dam site to Shashi would damage and losses be serious. Therefore, the civil defense issue should not become the decisive factor in whether the Three Gorges Project can be built.

Li Xu'e's Speech to Torch Plan Project Assessment Meeting

92FE0417C Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 20 Feb 92 p 1

[Article by Li Xu'e [2621 4872 6759], Deputy Chairman National Science and Technology Commission Standing Committee: "Several Torch Plan Problems. A Speech Made on 16 December 1992 to the National Level Conference of Torch Plan Project Evaluation Experts"]

[Text] In January 1991, we convened a special evaluation meeting on the national level Torch Plan project. I gave a speech at that meeting, and I capsulized the contents of the speech as 43210 [the meaning of which will be explained later]. I began by discussing what the Torch Plan means, going on to talk about what work should be accomplished within 2 years, and what goals are to be attained. This involved four reliances (4); doing good work in three regards (3), attaining the goal of a 20 billion yuan output value (2), and 10 tasks to be accomplished (10), which are written out as 43210, or 210 for short (Note: The four reliances are "reliance on the first productivity of science and technology, reliance on the policy climate, reliance on non-government flexible mechanisms, and reliance on the efforts of scientific and technical enterprises. The work to be done in three regards is: commercialization of research results, industrializing scientific and technical commodities, and internationalizing science and technology industries). However, the Torch Plan Office did not do much to publicize my ideas, so today no one talks about the 43210. The Torch Plan Office should be sure to come up with ideas. If you do not come up with ideas, you will have to publicize other people's ideas, and if you do not come up with your own ideas, and do not publicize other people's ideas, your work will become extraordinarily routine. Of course, with this year's merger of the Torch Plan Office with the Torch Plan Center, you are all very busy. Let us see what ideas you can come up with in 1992.

In the evaluation of the Torch Plan project today, all experts are using this opportunity to emphasize more concisely some of the major problems with the Torch Plan. I have no new prescriptions. Matters have advanced to a certain point where the major policies have been basically set. One cannot constantly change things around to come out with a new prescription every year. I prefer to link this 43210 idea to new developments in various problems concerned in talking to all of you again.

1. Development Zone Problems

On March 1991, the State Council approved additional national high- and new- technology industry development zones. At the end of April, we convened the first nationwide high- and new-technology industry development zone work conference. During the past half year, the situation has developed extremely rapidly everywhere. Today, there are a total of 27 development zones throughout the country, plus National Science and Technology Commission-approved zones and local development zones that local government have themselves approved, which makes a total of 40-odd. More than 40 development zones are bustling with activity. Governments in all jurisdictions are extremely interested in the development zones, some of them making the building and development of development zones the number one task for the whole city. At the very least, they are one of the several major tasks of the whole city. Some provinces and cities pin their hopes on the development zones.

The significance of building high- and new-technology industry development zones is very great. Virtually every coastal province has had economic development zones or special economic zones [SEZ] during the past several years, but some provinces and cities, notably provinces and cities in central and western China, have no SEZ and no economic development zones. Now, some cities in the central and western parts of the country also have State Council-approved high- and new-technology industry development zones having policies similar to those of economic and technical development zones. They regard the high- and new-technology industry development zones as their own SEZ. Possession of a SEZ can have a very great effect on a city's development. This is the first significance of these zones. The second significance is that everyone is gradually coming to understand the formulation that Comrade Song Jian [1345 0256] recently presented in a speech about industrial development having "one body and two wings:" large and medium size enterprises are the body; township and town enterprises are one wing; and high technology industries are the other wing. Having a body alone will not work; and naturally, only having two wings will not work either. I believe that nowadays all provinces and cities are moving ahead toward this pattern. Local comrades did not necessarily hear Comrade Song Jian's speech directly, but they have come to understand personally from practical work about the fashioning of a development pattern of "one body and two wings."

In 1991, the gross output value of township and town enterprises amounted to 1 trillion yuan, or 40 percent of the gross industrial output value of the entire country. This is already one wing about which there can be no doubt, and one that is of crucial importance. The other wing is high- and new-technology industry. Today, high- and new-technology industry is quite small, but it is a wing that must develop with all possible speed. If it does not develop, for cities this will mean no standing in the country; for the Chinese people, it will mean no standing in the world. Nor will China have an international standing. The last time that I went to Jinan to take part in a development zone's opening ceremonies, I made a speech in which I said the following: Jinan is historically a famous city in which every family has spring water and every household has drooping poplars according to the "Account of the Travels of Old Can." Everyone wants to come here to have a look. But during the past 10 years, the springs disappeared and the lakes dried up. But once

scientific methods were used, the springs began bubbling again this year, and very greatly. Therefore, unless you develop high technology industries, after so many years, Jinan will disappear from the map. This is because in the high technology industry realm you will be an "impoverished township in an out-of-the-way place" that is not important enough to appear on a map. They said that what I said was very profound.

Today there are some provinces and cities that would be heaven knows how happy if only a high- and new-technology industry zone were approved for them. They are filled with vigor and itch to invest their own financial resources into a development zone. Therefore, a lot of work is being done on various high-and new-technology industry development zones. Some comrades say that many enterprises have nothing to do, and their plant buildings are empty, while at the same time large scale construction of development zones is underway, which seems like a waste. Comrades working in industry and working locally understand this problem. When plant buildings are empty and you cannot go in, this is a systems problem that cannot be solved all of a sudden. Some people say that schools and research institutes produce enough results, so why do plants themselves have to do the same industrial development work? Why can't the results be just turned over to industrial plants? Everyone understands the reason why. I have been involved in scientific and technical research work for many years—first in a research institute and later on in industry. You might say that I have been engaged in scientific and technical work virtually all my life. I have some personal understanding of such matters. Since the 1950's, we have been talking about a tie-in between factories and research institutes, or merging plants with research institutes. But we have done very little about it. Likewise, some enterprises may be idle today and have many factory buildings, yet some Torch Plan projects cannot be accommodated in them. Naturally we hope for a tie-in between factories and research institutes, but this cannot be done easily. Consequently, in order to accommodate Torch Plan projects, we have no choice but to do a lot of construction in development zones. Torch Plan projects also have their own special character. Generally, they do not require large plant buildings; standard plant buildings will do. Why do I say this? It is because we will use projects to support development zones insofar as possible. Some Torch Plan projects are in development zones, and some are outside development zones. We must think of ways to support more development zone projects. We hope that national level projects can gradually be shifted toward the development zones, attaining a situation in which they are equally divided inside and outside zones. If this cannot be done this year, we must get half of them—or more than half of them—into development zones as quickly as possible. This is the only way to fashion a climate and an image of development zones as sites for high- and new-technology industry as quickly as possible.

2. Problems in Institutions of Higher Education Participating in Torch Plans and in Building Development Zones

In discussing 10 tasks at the beginning of the year, we spoke particularly about institutions of higher education. Most of the truly fine achievements come from institutions of higher education, yet few of the accomplishments of institutions of higher education are translated into commodities or industries. This poses a special situation and problems. First is the matter of whether institutions of higher education should be involved in high technology industry, and whether they should be involved in the commercialization and the industrialization of high technology achievements. So far there has been no identity of views on this subject.

For the past year or more, the State Science and Technology Commission and the State Education Commission have been making appeals about this matter, and now their understanding may gradually come to be accepted by some universities. Quite a few comrades believe that universities must become involved in the commercialization and the industrialization of high technology results. Universities have this responsibility. How can they claim not to have such a responsibility? This is because it is in universities that the greatest pool of human talent is located, the disciplines most complete, and actual results the greatest as well. It is only natural that they make a contribution to the state's development of high- and new-technology industries. That is why people say they have a responsibility. It is also possible for them to do this. Institutions of higher education have many old professors, and they also have quite a few highly qualified people. They can hire some young people to run enterprises, using the old ones to bring along the new ones. This also offers much potential. It is both possible, and it is also necessary. Institutions of higher education are very poor, yet they hold a treasure in their hands. Why don't they turn this treasure into wealth?

Not long ago, an institution of higher education held a conference to which they invited me. I went. I read one of their documents on industrialization in which one clause emphasized the need to couple industrialization to education, scientific research, and the training of students. I told them not to emphasize this. Just emphasize getting rich and making money. That's all that is needed. If you make money, soon you will be able to improve the old professors' dormitories and improve conditions for running the school and doing scientific research. Isn't that better than coupling teaching and research? If you emphasize that your projects should be coupled with teaching, scientific research, and training students, you will stymie yourselves. You should find out which projects will make money, then start work on those projects as quickly as possible. Now university leaders also realize that they lack money most of all. Therefore, they are gradually reaching a meeting of minds. They are also gradually gaining a little experience

through practice. They have a little understanding. Running a commodity economy requires lawsuits, but professors greatly fear lawsuits. They feel that going to court is shameful. I propagandized them. I said. No! The more lawsuits, the more that shows development of the commodity economy, and that is good. Don't be afraid to start a lawsuit. If you can't sue, get a lawyer to help you. You must learn to do this. So long as you are right, you have nothing to fear.

Some people suppose that doing research is high level, but doing development is low level. Such an understanding is an outworn concept that should be completely condemned. To say that it is an outworn concept is fitting. Some people even suppose that doing sales work is the lowest level; it is low class. All these ideas are an outgrowth of a society in which the commodity economy is not well-developed. In a society in which the commodity economy is developed, many important people started out as salesmen. But getting people to change these notions is still very difficult in our institutions of higher education. In one university, I saw some research results displayed in an exhibition hall. It was truly a fine thing, so I asked a person why he did not develop it. He said that low class people worked on gadgets like that; only people of not very high quality did such things. This is what a professor told me with his own mouth. Thereupon, Comrade Li Zhaojie [2621 5128 2638] told the professor that he was of high quality in teaching and doing scientific research, but the quality of people who do development and run things, who he might regard as low class, is also high. If all of the 1.1 billion Chinese only taught and did scientific research like you and did no development work or ran things, all of us would starve to death! Researchers who produce results are capable people, but people who are successful salesmen are also capable people.

I read on a notice board about a young sales manager in a Shenyang electric cable plant who looked to be slightly more than 30 years old. The plant had been losing money, but after she became sales manager, sales shot up to tens of million yuan within 2 to 3 years. People said it was all her doing. So who is the more capable person, she or a chief engineer?. I feel you cannot say that she is any less capable than a chief engineer. The Shenyang Electric Cable Plant is a large plant whose sales manager is slightly more than 30 and not necessarily a college graduate. But because of her sales work, the plant turned its losses into a huge profit. That's a great achievement, isn't it? Who is more qualified—the chief engineer, or the sales person? I say that both are highly qualified. He develops new products, and she sells new products. Both are indispensable. My hope in saying this is that more projects will be worked on in schools.

3. Torch Plans Must Be Coupled With Traditional Industries

I feel as though nothing has been done on this point. Just how can Torch Plans be coupled with traditional industries? It is not by working all by oneself, but by coupling one's own products with the products of traditional industries. Enterprises working on Torch Plan projects today, or enterprises in development zones are largely enterprises run by non-government mechanisms. Large and medium size enterprises are another kind of mechanism. Twisting these two kinds of mechanisms together is truly a difficult trick. Therefore, there is one very important task in our work during 1992, and that is to make major reforms in the development zones. We must prepare to make courageous reforms in the ownership system, the distribution system, the linking of the plan economy and market regulation, and social security in the development zones. Some provincial CPC committee secretaries say we must make reforms that will make others envious. I add that we must reform so that some people say they are "really bad." That will be all right. This is Chairman Mao's formulation. If some people say "really good," there are bound to be others who say "really bad." Therefore, reform must include how to couple together high- and new-technology industries with traditional industries so that they have a mechanism suited to this coupling. This is a task of reform. In our project evaluations, we must also do everything possible to pay attention to this kind of coupling.

4. Industrialization Problems

Certain trades and enterprises must be given special support. This was not done very well in 1991; some effort must be put into it in 1992. We cannot dillydally. We cannot dillydally in trades or enterprises. We must concentrate on key points that have good prospects, but that are fairly weak right now—biological engineering, for example. Biological engineering takes the smallest amount of money for the greatest amount of return. It is a vocation having a close relationship to China's 1.1 billion population, and it is also an industry. This kind of industry is just beginning in our country. It very much needs support. Entrepreneurs who have good prospects must also be given support so that their enterprises develop into leading enterprises more quickly, producing an annual output value of several billion yuan. Let them become real models. Possibly only one industry in a special development zone has an annual output value of more than 1 billion today, and that is the "Stone Group" [a computer company]. Several others exceed 100 million yuan. I feel that it is very necessary to have several firms making 100 million yuan or 1 billion yuan in every development zone for the development zones to succeed.

5. The Internationalization Problem

We have always called for a "Chinese-Chinese-foreign" model, doing all possible in the development zones to shape "China-China-foreign" enterprises, meaning enterprises that combine Chinese local policies, Chinese technology, and foreign capital and markets. Unless they can get into the world market, high technology industries can never become large. Since the domestic market sales volume is limited, industries cannot get large. Without comparing, contesting, and repeatedly competing with

industries outside the country, failing but then succeeding, high technology industries cannot grow up and move ahead.

We must take the internationalization road, and one very important shortcut on the internationalization road is to undertake "Chinese-Chinese-foreign" projects and to run "Chinese-Chinese-foreign" style enterprises in the development zones. Very great progress in this regard has ben made during the past year. Very many development zones have worked on "Chinese-Chinese-foreign" projects. We must provide earnest support where talks have born fruit and where talks are in progress. However, it is important to understand that it is high technology industries that we are supporting and not the processing of raw materials brought in from outside China to make high technology products. This is not within the purview of the Torch Plan. The products are high technology, but the technology belongs to others, the raw and processed materials belong to others, the parts belong to others, and the production lines belong to others. They just hire some of our young workers to work on them. Such projects are also needed, but such projects are not Torch Plan projects. They do not qualify for Torch Plan support. Torch Plans are supposed to develop our technology, or develop foreign technology. We can also develop technology that comes from abroad, making it succeed. But we cannot process high technology products from imported raw materials for foreigners.

The so-called three -izations in the Torch Plan are commercialization, industrialization, and internationalization. Commercialization is very difficult. Today, the greatest difficulty is in schools. Schools must be shaken up. Industrialization is very difficult too. The problem lies in dovetailing with traditional industries, as well as the capital construction needed in the development zones. Internationalization is even more difficult. The difficulty lies in an overwhelming majority of people in China, including those teaching in schools or those doing research in laboratories, or even those who have studied abroad not understanding what the international market is all about. They have never been mixed up in or rolled around in the international market. They can't say how to go about it. They are outsiders. After the internationalization problem was raised during the past 1 or 2 years, several measures were formulated to get going on this task, but progress has been slow. This has an extremely great deal to do with China's opening to the outside world, whether reform can truly be intensified, and whether the opening to the outside world can be truly enlarged.

Unless people are allowed to go abroad, how can there be any internationalization? The first requirement in opening to the outside world is for people to travel back and forth. Unless people travel back and forth, how can there be any opening to the outside world? In evaluating projects, we must do all possible to support projects that give impetus to the internationalization of Torch Plans. Specifically, "Chinese-Chinese-foreign" projects must be given all possible support. The several kinds of support I have just spoken about must be given equal priority provided they meet standards, no support provided if they do not meet standards.

The Torch Plan has been in existence for 3 years and 3 months, and it has truly gained some momentum. During March 1991, in particular, following approval of 26 development zones, momentum increased even more. This momentum, as I said previously, rests on four things: First, it rests on science and technology; second, on policies; third, on a flexible mechanism in high technology enterprises; and fourth, on the efforts of science and technology entrepreneurs. At the time, I felt it rested on a fifth thing, namely the working personnel taking part in Torch Plans, including you experts taking part in assessments and evaluations. Since the working personnel work on Torch Plans as a matter of duty, I did not emphasize them. Nevertheless, the momentum of Torch Plans today is attributable to the hard work and efforts of all the experts making evaluations and assessments. I want to express my gratitude to all, and I hope at the same time that everyone will continue to support the Torch Plan so that the torch burns even brighter.

The criteria that we use for Torch Plans should be widely publicized. One should be put up on tall buildings, one should be printed on envelopes, and one should be printed on workers' name cards so that they penetrate people's minds in time. China's Torch Plan is rendered CTP in English, but it is still like a torch. Finally, I hope that everyone will continue efforts, will add fuel, and will fan air to make the torch burn brighter.

Measures To Internationalize Torch Plan

92FE0417A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 17 Feb 92 p 3

[Article by Ye Jitang [0673 0679 0781], Torch Plan Office, State Science and Technology Commission: "Exploration of the National Torch Plan Internationalization Strategy"

[Text]

I

China's Torch Plan was approved by the CPC Central Committee and the State Council in August 1988, and the State Science and Technology Commission organized implementation of a guiding plan that aimed at the commercialization, industrialization, and internationalization of results obtained in the high- and new-technology research field. This plan features a market orientation, high investment, high output, and high returns. Since the Torch Plan not only seeks to turn scientific research results in the high- and new-technology field into products as rapidly as possible, translating them into economic productivity to give impetus to economic development, while commercializing them at the same time to gain the economies of scale, powerful market support is needed. China's

market potential is very great, but China is a developing country after all. Neither the nation nor its people are very affluent as yet, and prices of high technology products are relatively high. This, plus the difference in educational level, means that the domestic market is limited. Therefore, moving ahead with implementation of the plan to develop the country's high technology and products must be done under guidance of the policy of reform and opening to the outside world, removing restrictions and cooperating in every way to move into the international market, using the international market to support realization of a global market internationalization strategy.

Internationalization of the Torch Plan means the development and production of high- and new-techology products, particularly products of a strategic nature, that meet international market demand by relying on results obtained in China's high- and new-technology research. Next, is further development in accordance with international market specifications, packaging, and styling to meet international market requirements in order to take part in international market competition. Second is for the country's competitive high technology business concerns to use various means such as joint venture shareholding in conjunction with enterprises in foreign countries or territories, the opening of offices or commercial sites (retail sales outlets), the purchase of foreign enterprises or business establishments verging on bankruptcy, and operating factories, establishing companies, developing products and opening markets in the establishment of our own marketing channels for entry into the international marketing network. Third is exchanges with everyone abroad and cooperation at different levels for implementation of the Torch Plan, the development of high- and new-technology and industries, and the building of high- and new-technology developmental zones. Therefore, one might say that the key to whether China's high- and new-technology and industry can rapidly develop lies in internationalization, which is also the key to whether China's Torch Plan can be smoothly implemented.

2

Moving ahead with development of China's high- and new-technology and industry to internationalize the Torch Plan requires a brief analysis of the current state and nature of the international market, as well as China's current position in it, using this as a basis for studying and finding an internationalization strategy that fits China's circumstances.

With the advance of science and technology by leaps and bounds, the globalization of markets and the intensification of competition have become an important feature of markets everywhere. Both newly industrializing counties and old industrial countries alike are all seeking means to dump their products everywhere in the world, and to turn over to the Third World their outdated technologies or products, high energy-consuming, large raw materials-consuming, seriously polluting, and labor intensive production lines or equipment. Numerous American monopoly business conglomerates and supra-national corporations have very successfully internationalized, their products and network outlet points virtually blanketing the world. Japan has been even more pushy, adopting an aggressive policy in world markets. Preliminary statistics show Japan as holding between 30 and 75 percent of the world market share for very many goods. The economic development of Asia's four small dragons has produced a new competitor in world markets. The products of industrially developed European countries such as Germany, France, and the United Kingdom not only dominate the European market, but also account for a substantial share in international market competition. In a situation in which the markets of capitalist industrialized countries and territories are relatively saturated, competition is becoming increasingly intense, and both the difficulty of opening markets and the expenditure of money required to do it are becoming greater and greater. The areas to which their products are exported and in which they compete will gradually shift toward Third World countries and territories whose industrial foundation is relatively weak and who are in process of developing their economy. Future competition in the globalized market will become more intense in every area and corner.

Short product life, rapid updating of products, and ever higher consumer demand for quality and repair services are other major features of the international market. In order to meet changes in the market, every country and every business enterprise is working feverishly on the development of new products. They are using every method and means to accelerate new product research and development in order to shorten the time between new product development and application. Intense competition and a rise in customer consumption levels pose ever higher demands for product quality and styling, and the provision of repair services. The need to consider prices of comparable products is also more important.

The existence side by side of partnership and competition in international markets, the formation of conglomerates, and regionalization are a third feature of the international market. In order to obtain and divide up world markets, every enterprise and every entrepreneurial bloc enter into mutually beneficial partnerships that can squeeze out and topple their adversaries. At the same time, the number that build integrated research, development, production, supply, and marketing in order to concentrate their capital is also becoming greater and greater. Simultaneous with the market globalization of enterprises strength, product types, specialization, and customer demand is a gradual regionalization that permits enterprises to respond to the market more rapidly and with lower costs.

The fourth characteristic of the international market is its protectionist and trade barrier policies. In order to

protect the market, every country has adopted measures that include the raising of tariffs on imports.

In 1990, China exported $71 billion worth of goods, but high technology products accounted for less than 5 percent. This is extremely at variance with China's international standing. We must realize clearly that many fields and areas of the international market are occupied by developed capitalist nations. In dividing up the melon, they are unable to yield certain markets to us. This applies both to the social system and to economic benefits. On the contrary, they employ certain advantages in technology and products to exclude our goods. Although China holds an advantage in resources and cheap labor, relatively low product costs, and market prices that are relatively cheap, because of poorer quality, unattractive styling and packaging, and some products that do not meet international standards, and particularly since repair services do not meet customer requirements, they cannot compete in international markets. China's foreign trade relations with enterprises operating outside China, particularly high technology enterprises, are not smooth and policies are not coordinated. Procedures for the travel of personnel from China abroad are difficult and take a fairly long time, so China cannot make direct contact with foreign customers or provide prompt and rapid service on goods sold abroad; consequently it has lost many business opportunities. The economic decline that has resulted from the current political changes in eastern Europe have produced a market vacuum. At the same time, the investment climate in east Germany is steadily improving. Many countries have seized this opportunity to jump into east Germany. They want to use east Germany as a base for entering the European market following unification of the European market, and as a spring board for getting their foot into the east German market. Should China's business concerns, particularly its high technology business concerns be unable to seize this opportunity to make a lodgement in east Germany or Europe, as well as in other places in the Americas, it will very likely sustain irremediable losses in creating and entering the European market as well as the American market.

3

Internationalization of the Torch Plan requires formulation of international strategic development plans and specific plans for their implementation, different stratagems and methods adopted for the different international market characteristics. For example, the supranational corporations of industrially developed countries have advanced technology, highly automated equipment, quality, variety, and specifications that better meet customer demand. They can compete in markets, and they have plentiful experience in opening markets. For the most part, such corporations do not have a high regard for China's technology, nor do they want to make us become their market competitor. Therefore, full cooperation with them on technology is impossible. They can only select certain of our technologies and products to supply parts for their product lines as required and in order to lower product costs. They become limited cooperating partners. We can only make use of our limited advantage to enter into cooperation to a certain extent with these supra-national corporations. At the present time, the partners with whom we can cooperate most readily must be medium and small foreign enterprises. These concerns generally are very tuned in to market information, are flexible, and highly adaptable. They also have a certain amount of experience in opening markets abroad. However, they are relatively lacking in investment capital and the ability to develop new technology. They are looking for suitable partners with whom they can cooperate. Such corporations are our main targets for cooperation, and our main partners in globalization of the Torch Plan.

Since developed capitalist countries or territories are unevenly developed economically and technologically, even though many fields and areas of the international market are monopolized by or divided up among supranational business conglomerates, China can adopt a fairly flexible international strategy nevertheless. It can select relatively weak areas in industrially developed countries such as east Germany or the south of France. Second, Australia has plentiful resources, but technologically it lags behind the industrially developed countries, particularly in high technology. We can make full use of our technology and local resources to operate plants in Australia, selling the products on the international market. The southeast Asian region is closest to China; it is readily accessible; and it is culturally and historically similar to China in some regards. Since it is in process of developing, it should be an extremely important area for the internationalization of China's high technology industries. Cooperation with Japan and South Korea can be only limited and selective. The North American market is very large, but long preparation and judicious selection of partners for cooperation will be necessary in order to get a footing in North America. Use of the mainland's scientific and technical achievements to keep Hong Kong booming, and fullest use of the advantages that Hong Kong's communications and transportation, availability of information, and position as an international financial center provide in making Hong Kong an important base and window for China's high technology and internationalization of its industry should be problems that are seriously studied and diligently solved. China's high technology products can be further developed jointly with Hong Kong business concerns on the basis of market demand for entry into the international market. Mainland high technology enterprises can set up sites in Hong Kong, or operate enterprises jointly with high technology groups and enterprises in Hong Kong to develop products and open markets.

4

The international situation is changing today. The world is regrouping along power lines. We must seize the

opportunity, taking vigorous action to advance the internationalization of the Torch Plan in order to advance the development of China's high- and new-technology and industry.

1. Torch Plan internationalization requires powerful support from government at all levels. Heightened understanding of the high- and new-technology and the internationalization of industry must form the basis for vigorous actions that create a favorable climate for advancing the internationalization of the Torch Plan. The frequency with which China's high- and new-technology enterprises come in contact with the market environment abroad must be increased to provide Chinese entrepreneurs more opportunities and conditions for understanding the international market and for taking part in international competition. This includes the formulation of preferential policies to advance high- and new-technology and product exports; continued liberalization of policies and further simplification of procedures for scientific and technical personnel, and for personnel engaged in international market dealings to leave China, particularly to travel back and forth to Hong Kong and Macao; formulation of preferential policies to support high- and new-technology enterprises in setting up sites and operating plants in Hong Kong and Macao for the development of products and the opening of markets; support for high- and new- technology enterprises in China to operate plants abroad as the international market requires, to establish sales network outlet points (including repair service), to purchase plants available at a low price, whose technology is high, and that China urgently needs, or to enter into joint ventures or cooperative plant operation abroad. High technology enterprises that operate plants abroad should be provided support in developing products, opening markets, and establishing high technology product marketing networks of their own that can compete internationally. In addition, the existing foreign trade system should be appropriately reformed to give some high technology conglomerates authority to deal directly abroad on products; foreign trade channels should be streamlined; foreign trade procedures should be simplified, and the amount of technology that goes into foreign trade products should be increased. Additionally, the state must provide financial support. Promoting the high- and new-technology and the internationalization of industry also requires further improvement of various associated facilities in China such as the transportation and communications network. The investment climate needs further improvement. The regulatory system, which interferes with the improvement of efficiency and holds back the development of productivity, should continue to be reformed to enable the rate of return on foreign trader investment to remain at above 13 percent.

2. Efforts to increase the competitiveness of high- and new-technology enterprises. While invigorating large and medium size enterprises to improve their economic returns, emphasis must be placed on improving their ability to open markets to increase their competitiveness.

(1) Most of the products that China produces are cheap and substantial, but their styling, packaging, color and variety, and quality standards frequently do not meet international market requirements. As the standard of living rises, many customers are only secondarily interested in product price. What they usually require is quality, color, and variety. China has cheap manpower, but with the rapid development of high technology, this advantage may be gradually lost. China's labor productivity rate is lower than abroad. In order to change this situation, China is currently adopting various measures to liberalize and invigorate large and medium size enterprises. These include having enterprises raise their own capital, make decisions about their own operation, be responsible for their own profits and losses, and be responsible for their own development. These measures apply to high- and new-technology enterprises as well. Giving enterprises greater decision making authority is necessary in order to raise the labor productivity rate and economic returns, and to improve enterprises ability to respond to the market so that they can truly produce the readily marketable goods that customers want.

(2) China's enterprises do not have ready access to market information, particularly international market information. They lack the necessary channels for obtaining and relaying market information, and they lack research on customer psychology. Consequently, many of the products that China produces do not meet international market needs, or may not even satisfy the needs of the domestic market. Thus, commodities that find no market pile up in inventory tying up funds. Improvement of enterprise competitiveness requires vigorous improvement of prevailing conditions, various means and methods use to acquire most rapidly information about changes in the international market, to find out about competitors, and to analyze fully in what areas competitors are at an advantage or a disadvantage in comparison with one's own enterprise to enable China's enterprises to know themselves and know their opponents, make the most of their advantages, and overcome their shortcomings.

(3) Improvement of enterprise and product market competitiveness requires efforts to develop new products steadily, shortening the new product development time. Enterprises used to be judged on the basis of their investment and the quality of their products, but today the time element has to be added to these criteria. The ones who run the fastest, and the ones who take the opportunities are the ones that dominate the market and survive. Formerly many enterprises were accustomed to following a conventional sequencing that went from research to development to production to marketing. Today, some industrially developed countries such as Japan and Germany are experimenting with simultaneously carrying on research, development, design, technology, and production, eliminating the former traditional sequencing.

5

In today's world, competition and cooperation (or partnerships) exist side by side in obtaining markets, and in

controlling and monopolizing markets. Competition is a necessity for all countries, all territories, and all blocs in order to protect their own interests and to gain a greater degree of survivability. The goal of cooperation is to increase one's strength further in order to be able to compete on a larger scale, monopolize markets, and make a profit. Partnerships between conglomerates, and partnerships between supra-national corporations is the inevitable outcome of the intensification of international market competition. Such partnerships among enterprises for common benefit is particularly prevalent among medium and small enterprises. Since the advent of the Torch Plan in China, a substantial number of medium and small enterprises, as well as non-government operated enterprises, have also contracted projects. In general, they possess flexibility in operation, have fairly strong ability to respond to the market, and have a fairly high labor productivity rate. However, they lack money, are not very strong, and are unable to open international markets much less contend with supra-national enterprises. Thus, they need national policy support that permits their gradual formation of partnerships. Only partnerships can increase the strength and improve the competitiveness of enterprises, particularly of non-government enterprises, and of medium and small high- and new-technology enterprises. Such enterprises must even more adopt various forms of partnership, support each other on the basis of equality and mutual benefit, and take a course toward the formation of enterprise groups and blocs. They must overcome their traditional small scale production mentality, and truly come to understand that "partnership" is a necessity for thorough development of the Torch Plan, and a necessity for increasing enterprise's strength and for taking part in international competition. Only through "partnership" can medium and small high-and new-technology enterprises (including non-government enterprises) use their advantages more fully.

4. The role of publicity and advertizing must be noted, major efforts made to create logos and trademarks for China's high- and new-technology enterprises and products. Advertising and publicity are major media for developing markets and making product sales, which are needed not only during the market development stage, but also during the period when product sales are rising. The major problems today in advertising and publicizing the country's high- and new-technology enterprise products are as follows: (1) Insufficient understanding of the need for advertising and publicity resulting in unwillingness to spend some money on advertising and publicity. (2) Lethargy in advertising and publicity that results in failure to seize the moment, use every opportunity, and leave no stone unturned. (3) Advertisements frequently pay attention only to a product's level of technology, its status, or how many awards it received without noting its utility, or its economic and social benefit to customers, i.e., products are not advertised or publicized to take full advantage of the customers' psychology. (4) Ineptness in making use of the opportunities that various kinds of fairs provide for advertising and publicity to develop new product sales channels.

A trademark is a specific mark that an enterprise uses to sell a commodity. It symbolizes product quality and reputation. Trademarks are indispensable in a commodity economy. Trademarks themselves are worth money. Reportedly a good trademark is worth between five and ten times the value of an enterprises' total fixed assets, and it can make enterprise management more scientific and improve product quality. Trademarks are also necessary to the internationalization of the Torch Plan. During the early period of entry into the international market of China's high- and new-technology enterprises and products, when we lack experience in the opening of markets and when a new product still lacks market recognition, use of other people's trademarks to sell products is possible, but it cannot meet needs for long. An enterprise or a product that uses the trademark of another to make sales will actually be highly exploited by the owner of the trademark. Quite a few foreign traders have used this technique to enter into long-term contracts. They purchase products at cheap prices from some of our factories for sale under their trademark. They become rich by using a trademark that the factory cannot use itself. This is extremely unfair. Escaping from this predicament and unfair sales method requires that enterprises nurture and establish their own name brand trademark in a planned way. Establishing a trademark takes time, and it takes money as well. One has to go through a long period of arduous efforts and constant tempering through competition to do it. Only by establishing our own trademarks can our country's high- and new-technology enterprises and products become truly international, can the reputation of our own enterprises and products be truly established, and can we gain a foothold in globalized market competition.

Participation in fairs, particularly international fairs, is also a major means of internationalizing the Torch Plan. Fair participation permits direct contact with customers. Fairs and performances permit us to publicize our own products, to search for cooperative partners, and to expand contacts with customers. In addition, fairs permit us to gain an understanding of the market for various products, product trends and changes, styling changes, and such market information. It permits understanding of product competitors that is helpful to enterprises in studying and drawing up new product development plans and marketing strategies. China has had successful experiences and learned the lessons of failure from the very many international fairs (and exhibitions) it has run or taken part in during recent years. However, most units that run fairs are mostly interested in making money for themselves, not in providing enterprises opportunities for marketing products and opening markets. They do not provide effective service, and they lack the ability either to attract units to take part in the fairs or people to attend them. As a result, enterprises have lost confidence and interest in fairs. Some who take part

in fairs themselves have no goal in participating, and they are uncertain about their significance as well. They do not prepare themselves fully; they lack market information and analysis of customer psychology; and they select products for display that do not sell. In addition, the materials they exhibit and provide are shoddy; they lack a correct marketing and exhibition strategy, and consequently they fail to get the results they should. International fairs nowadays are tending to become specialized, and regularized. They are held at certain times in certain places, becoming events at which information is most readily available. Therefore, good preparation to take part in or run an international fair is really an important activity that is indispensable to the internationalization of the Torch Plan. The problem is step-by-step improvement of returns from taking part in and running international fairs, guarding against formalism.

5. Training of human talent that understands technology, can manage, and is able to open international markets is basic for the internationalization of the Torch Pan.

High- and new-technology and the internationalization of industry has a bearing on politics, economics, technology, administration and management, and foreign trade. It is an extremely complex and daunting task of a strategic character. Since China has been involved in the development of high- and new-technology and industry for only a relatively short period of time, it has not caught up with needs in the development of managerial skills and quality personnel. It particularly lacks a corps of people that understands technology, can manage, possesses an understanding of international trade, knows the way that foreign business concerns work, and related laws, tax, fiscal, and financial systems, and that can open international markets. The Torch Plan has been in effect for more than 3 years, yet some fine projects have yet to produce value on a scale that meets anticipated goals. In addition to insufficient investment, the key problem has been that markets have not been opened. Consequently, the market question is the key to the ultimate success of the project. Having products for which markets must now be opened is a problem much more difficult than having markets that one must develop products for. Solution to this problem will require not only attention to research and development, production, and management of products themselves, but also diligent attention to business, sales, and the opening of markets, the development and training of a corps of people possessed of fine political attributes, that does not fear difficulties, that is willing to dig in, that has the public welfare at heart, and that is able to open up the international market. Great efforts will certainly have to be made, and training in both China and abroad together with tempering through practice will have to be provided to fashion a corps of a size that meets the needs of China's high- and new-technology and the development of products. All local governments, science and technology groups in all units, and high- and knew-technology industrial development zones must make the training of high level management personnel and managers, and market opening personnel a part of the plan. They must give them the same important position on daily agendas as the establishment of Torch Plan projects, and the building of high- and new-technology industrial development zones, positively not slackening efforts. Otherwise, the internationalization of the Torch Plan will come to naught. As the development of the Torch Plan proceeds, the internationalization has become the key to its smooth implementation. In today's changing world when markets are becoming globalized, and competition is becoming more intense, China's high- and new-technology enterprises and products face very great difficulties in entering the international market to compete internationally. The task is a very daunting one, so we must measure it well. Thus, we must make major efforts to create the environmental conditions in terms of policy and funds that help China's high- and new-technology enterprises and products enter international markets. While reforming and opening to the outside world, we must adopt effective measures for concentrating our energies, seizing opportunities, positioning ourselves favorably, and doing a solid job. With effort, the internationalization of China's Torch Plan, that takes its high- and new-technology and industry out into the world is entirely possible, and holds great hope as well.

Impact of S&T Achievements During Seventh 5-Year Plan

92FE0310A Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 6, Nov 91 pp 1-6

[Article by the General Planning Office of the State Science and Technology Council; editor in charge Zhang Wanbin [1728 8001 2430]]

[Text] Today the Chinese people are working hard to achieve the second phase modernization strategic targets of the Eighth 5-Year Plan and the 10-year plan. It is crucial for the success of the Eighth 5-Year Plan that results and experience of the Seventh 5-Year Plan be consolidated.

In the Seventh 5-Year Plan there were 76 priority projects, 4,696 special topics contracts, involving more than 130,000 people and costing 6.76 billion yuan. At the end, 4,292 of the contracts were completed and 10,462 S&T results were obtained. Fifty-eight percent (6,068) of the results achieved international standards of the 1980s, 39.3 percent of the results (4,112 items) filled a void in China, and 39.8 percent of the results (4,167 items) were of leading domestic quality. A total of 155 national awards, 1,127 provincial S&T awards, and 334 patents were received. Eighty percent of the results were applied in production to various degree, generating 40.67 billion yuan of economic benefits. Through the concerted effort, a large number of key problems in the development of the national economy and the social

development were solved, the technological capability was changed, and the economic strength was enhanced. These achievements played a major role in economic development through S&T and in improving the quality of the workers. In the space below, major achievements of the Seventh 5-Year Plan are reviewed.

I. Breakthroughs in Agriculture Guaranteed Stable Production and Growth of Food Crops, Cotton and Oils

During the Seventh 5-Year Plan period, 397 new species in 14 categories of rice, wheat, corn, cotton, soybean, and rape were developed, 640 million mu of field was planted, the food crop production increased 14 billion kilograms, and the cotton production increased 330 million kilograms. The yield of the "Te-Qing No. 2" rice was 825 kilograms per mu. For large area farming, the traditional rice competed with hybrid rice. The per-mu yield of the "Shaan-nong 7859" wheat and the "Yang-mai No. 5" were 770 and 600 jin respectively. The new strains were adaptive and fast growing. Compared to the control group, the Shaan-nong 7859 and the Yang-mai No. 5 out-produced their counterparts by 13.2 percent and 16.4 percent. New advances were made in the yield, disease resistance and quality of cotton. The "Zhong-mian 16" short-season cotton has good quality, early harvest, and high yield. The long desire for harvesting cotton and wheat has finally been realized. The "Zhong-mian 12" produces 98.1 kilograms of cotton, 12 percent more than its counterpart. In 1990 China planted 1900 mu of "Zhongmian 12." New breakthroughs were made in the breeding of soybean and rape. Fifty-eight new species of soybean were planted in 2,688 mu and increased the production by 400 million jin, thus creating 430 million yuan in economic benefit. The quality of rape was improved from low in erucic acid to low in both erucic acid and theoacetic acid. Innovations in breeding technology has produced initial results for wheat, grain, rape, and rice. Prevention for pests and disease for major crops has led to a preliminary integrated system. Standard resistance measurement methods have been developed for 24 major pests and have substantially lowered the amount of pesticides used. In low to medium production areas on the Huanghai and Huaihai plains, 12 integrated management model zones, occupying a combined area of 217,000 mu, have been established. Acting as seeds, these model zones have led to 3.69 million mu in demonstration zones around them and 7.24 million mu in diffusion zones. The agricultural projects in the Seventh 5-Year Plan produced 1,109 results, planted 924 mu of land, increased food production by 17.3 billion kilograms of grain, and created 15.4 billion yuan in economic benefits.

The main effort in forest development was to speed up the growth of man-made forests. Experiment and demonstration forests of various kinds have been planted in 443,700 mu. A series of fast-growing and high-yield forest and special forest product bases have been established. Over 6,000 mu have been planted in the past 5 years. Five culture seedling and container seedling plants have been established in south, north, northeast and northwest China. The timeframe for raising seedlings has been shortened by three-fourths. A system for cultivating fast growing major tree species has been formed, which has improved China's artificial forestry to a new level. The "three north" forest protection project showed that large scale greening of the desert and semi-desert has led to pronounced environmental benefits.

In the area of animals, fowl, and fisheries in the Seventh 5-Year Plan, three male and seven female lines of lean meat pigs with good meat quality and high reproductive ability were established. Of the seven pedigrees of fast growing good quality yellow feather meat chickens, four have completed breeding with high-yield laying chickens. Two new breeds of sheep with semi-fine fur were developed. Also bred were 13,950 high-quality black and white Chinese milk cows and eight varieties of high-yield fish.

In the area of food and feed industry, a world class production shop was set up to handle 10 tons of frying oil per day. Also built was a demonstration production line for continuously refining 50 tons of vegetable oil a day. Fourteen new varieties of corn and potato starch were developed and produced in 17 intermediate production lines, creating 13.7 million yuan of revenue per year. Cold-train transport of fruits and vegetables was achieved for the first time in China, reducing the loss from 20 percent to below 10 percent and creating more than 80 million yuan in economic benefits. Twelve animal and vegetable protein feed production lines for intermediate testing were built. A number of advanced fermentation techniques and controllable solid fermentation methods were developed to treat waste liquids and fibrous wastes. A series of single-cell protein feed intermediate testing facilities and bases were established. These facilities have basically formed a system for feed processing. More than 50 feed resources were developed, creating 6.7 million yuan. Thirty-six superior species of sugar cane and beets were developed and planted on 22.907 million mu, leading to an increase of 460 million kilograms of sugar with an economic benefit of 850 million yuan.

II. A Number of Key Difficulties Were Solved To Change the Backward State of the Equipment

In the petroleum industry, directional well and cluster well drilling technology has reached the 1980's state-of-the-art. In Liaohe, Shengli, Dagang, and Sichuan oil fields, 443 groups of cluster wells and 1,427 directional wells were drilled, resulting in a saving of 7,187 mu of land and 260 million yuan of investment, and leading to an increase in production by 18.23 million tons. High resolution earthquake exploration techniques have perfected the interpretation of thin plates, small faults, small fault block, and small amplitude structures and improved the resolution by 100 percent. China has also independently developed a 240-channel and a 480-channel seismogram as replacements for older models.

Advances were made in high efficiency coal mining equipment. For complex geological conditions including the "three hard," "three soft," and big inclines, different models of combines, high power crawlers, big incline transport belts, coal galley and half-galley tunnelers, rock galley hydraulic drills, and 1.2 meter diameter reverse well drills have been developed. The "three soft" coal seam solidification technique has been applied in four mining bureaus including Pingdingshan. It improved coal production by 100 to 150 percent.

Breakthroughs in low temperature nuclear reactors for heating produced first rate results. China built the world's first natural circulation, shell type unitary 5 MW low temperature heating reactor. This reactor serves as a technical demonstration and design base for building 200 MW heating reactors in the Eighth 5-Year Plan. Breakthroughs in uranium isotope separation led to the development of the NC-10 centrifuge. Stable operation and large scale physics experiments have been achieved. Five demonstration points have been established in Anshan Steel and Wuhan Steel for the oxygen turning furnace top-bottom combination blasting technology. A new processing scheme involving different forms and different stages of liquid iron pushing treatment, converter-repeated blasting, external refining, and continuous casting has improved the product quality and saved a large amount of energy. Six continuous cast setups have been built for continuous casting of special steels. An annual production ability of 690,000 tons was achieved. Twenty-five special production lines were perfected for rolling medium and thick steel plates and quenching full length steel rails. Ten of these production lines have achieved international state-of-the-art. A new mining technique of doubang [7107 1620] mining for large open pit mines was used in Nanfen iron mine. This process reduced the mining rate from 2.7 tons per ton to 2.4 to 2.5 tons per ton, thus reducing the amount of investment needed, accelerating the construction process and reducing the costs.

Successful development of sintering techniques, Bayer process, and unified method for producing aluminum oxide grains has put China among the most advanced in this technology. Energy conservation in the electrolysis of aluminum has produced good results.

To improve the pulling power of the locomotive, a 140 km/hr, 3,020 kW Shaoshan-5 passenger electric locomotive, and a 3,040 kW Dongfeng-9 passenger internal combustion locomotive were developed. These two models have increased the percentage of internal combustion and electric locomotives from 34.8 percent during the Sixth 5-Year Plan period to 53.8 percent. The towage mileage has also increased from 28.2 percent to 43.2 percent, thus putting an end to China's history of steam engine production. The average towage of freight trains was increased from 2,211 tons to 2,414 tons. While the increase in operation mileage was only 1.02 percent, the passenger and cargo turn-around has increased by 47.52 percent, with great economic benefits. The double-deck passenger car put into operation on the Shanghai-Ningbo line used 10 new technologies and materials; their passenger capacity was 60 percent greater than a regular train and the oil consumption was 350 tons per year less.

China has learned the basics in the design, construction and management of advanced highways, which form the technical basis for building expressways. Based on the characteristic large water level difference in the Chang Jiang river valley, two new types of wharfs for river navigation were designed. One was a sloped wharf designed for large water level difference and the other was a large-tube pile wharf built with pre-stressed concrete. These new wharfs reduced investment by 40 percent. Using a 400 to 1,200 ton per hour gantry crane, the operation of river wharfs has been serialized, thus changing the long practice of using an ocean harbor gantry crane on river wharfs.

In the construction material industry, 85 percent of the outside cement kiln decomposition facilities have been made in China. Nine 2,000 ton/day production lines have been built or are under construction; six of them are for exporting to Southeast Asia to create $80 million in foreign exchange. Based on the 500 ton/day floatglass production line in Qinhuangdao, 14 floatglass plants are under construction or being remodeled. One production line was exported to Indonesia. This technical level in China for floatglass production has made great strides toward the advanced state-of-the-art. The energy consumption was reduced by 30 percent, with noticeable economic benefits.

The petroleum industry in China has obtained 37 important results and 9 patents for lightening crude oil. The implementation of these results has created 160 million yuan of revenue and saved $10 million of foreign exchange. Facilities for bitumen removal from residual solvent have reached the 600,000-ton level, high pressure hydrogen cracking facilities 800,000 tons, and modulated hydrogen cracking 220,000 tons. The rate of domestic production for prototype furnaces of 20,000 and 10,000 ton capacity for large-scale ethylene cracking are now respectively 97 percent and 89.7 percent; the technical level has reached the 1980's world standard.

III. Domestically Produced Major Equipment on the Rise

Single-bucket cars for open pit mining with an annual yield of 10 million tons are now made in China. Nineteen systems of major equipment are now mass produced in China, including a 12 cubic meter electric shovel, 108-ton electric wheel self-unloading cars, and 320-horsepower bulldozer. Mining equipment for open pit mines with an annual output of 20 million tons are gradually achieving domestic manufacture. Seventy percent of the 154-ton eletromobil and 60 percent of the 16 cubic meter and 23 cubic meter electroshovel are made in China. Giant engineering tires 3.5 meters in diameter have already been in use and the average life was 27,000 kilometers.

Based on imported technology, 300,000 kW and 600,000 kW thermal electric generator sets were successfully developed. Indigenous development ability has greatly improved and more than 88 percent of the main frame of these two types of generators are domestically supplied. China's first generation 500,000 volt AC power transmission and transformation equipment, a total of 35 types and 214 units have been put into operation on the Jin-Liao line and were certified by the state. China's second generation 500,000 volt power transmission and transformation equipment, for a total of 248 units in 19 different models, has been put into use on Jin-Jing line, Gezhouba, Yuanboshan, and the second phase construction of Liao-Yang. Audits showed that the comprehensive technological and economic index has increased substantially.

Heavy hauling trains of the Daqin Railroad and engineering systems of large harbors have laid a good foundation for the first phase construction of the Daqin line; more than 50 million tons of coal from Shanxi have been shipped. The successful development of the 10,000-ton heavy-duty train has elevated the technological level of the heavy transport train to a new height. The automated control system of the phase III engineering project of Qinmei wharf was developed and installed by the Chinese after the contracted foreign company went bankrupt. This experience has advanced China's harbor installation standard one step forward.

With foreign cooperation in design and manufacturing, equipment for the second phase Baoshan steel plant, including 2,050 hot roll, 2,030 cold roll, and 1,900 continuous casting, have been successfully produced. Domestic production has also been extended to the 4,063 cubic meter blast furnace, 450 square meter sinter machine, and 6 meter coking furnace and achieved the international standards of the 1980s.

The electron-positron collider in Beijing is a state-of-the-art high-tech project designed and built by the Chinese. The average annual operating time is 5,000 hours since it was built. Good results have been obtained in basic research and in the area of elementary particles. These results have earned international praise and special Chinese national prizes for advances in science and technology.

Progress has also been made in the front-end work of the Three Gorges hydroelectric power project and the manufacture of large-scale equipment systems for hydroelectric power, chemical fertilizer, and coal gas.

IV. New Technology Development Centered on Electronics and Information Has Made a Good Start in Reforming Traditional Industries

In the area of LSI circuits, China has developed a computer supplemental system with 100,000 transistors and 487 CMOS special function ICs; 122 of them have been put into production. In the last 2 years China has also developed its 1 nanometer manufacturing technology and produced a 1 megabyte Chinese character ROM, containing 1.06 million transistors. In the area of computers, China can now produce 70,000 16-bit computers per year. The foreign exchange it created has increased from $10 million in 1986 to $225 million in 1990. China can also produce 300 units of 32-bit machines per year. China has established its position in the development of computers compatible with Chinese characters and western language, and in the research of new input systems for Chinese characters and character recognition technology. Computer-aided design (CAD) has caused a revolution in product design and engineering design; in the last 5 years China has independently developed patented software support systems. The Ministry of Electronics has applied CAD to the design of 24 high priority products, reducing the design time by 1/3, with a 90 percent success rate. CAD has been promoted to 294 enterprises in the design of 3,858 new products. Computer aided design of advanced highways and bridges has improved the efficiency by three times, the drafting efficiency by 20 times, and reduced the volume of earth work by 5 to 10 percent; it has been used in 19 ministries and provinces. CAD has also helped the shoe industry in advancing their technology.

In the automatic control of industrial processes, China developed a DJK-7500 distributed control system and provided hardware and software systems for its electric power, metallurgy, and petrochemical industries. The data processing accuracy and reliability of computer control systems for fertilizer production have reached international standards. With computer control, the energy consumption of the 200,000-ton synthetic ammonia facility of Sichuan Chemical has dropped from 13.50 million kilocalories per ton to 7 million kilocalories per ton. The system has been applied to 15 large-scale chemical fertilizer plants in China. Computer control of 600,000 ton alkali manufacturing facilities has also been improved, resulting in great economic benefits.

Numerical control played a major role in the technological improvement of the machine tool industry. The types of numerical control has increased from 8 to 55 and 200 models of NC machine tools have been developed. Data from 87 machine tool plants show that the value of numerical control products has reached 230 million yuan and $20 million of foreign exchange was created. In the area of flexible manufacturing systems, four demonstration production lines have been built to promote the development of numerical control technology.

Robotics is a multidisciplinary technology. In the Seventh 5-Year Plan period, 10 robots of six different types were developed. Robots for spray painting, spot welding, arc welding, moving, assembly, pressing, and die casting have been in small-scale production. Ninety percent of the components used in these robots were made in China and the major specifications of the robots have reached foreign standards of the 1980s. The robot automatic spray paint assembly line at the No. 2 Automobile Plant has increased productivity by 200 percent. The savings from spray painting alone was 2.3 million yuan per year.

Computer application in railroad transportation has made breakthroughs in the automation of classification station operation. The north classification station of Zhengzhou, the largest railroad hub in China, has developed a freight car information management system and an operation process automation system, which put more than 10,000 trains on over 100 lines in the station under computer control. The efficiency was improved by 15 percent and the economic benefit per year was close to 100 million yuan.

In the area of optical communication, domestically developed triple-group optical communication systems have been employed. A total of 2,880 kilometers of optical cable has been deployed. The performance level has reached international standards but the construction cost was only half that of coaxial cables. Quadruple-group optical communication systems have been installed for the relay between Tianjin and Tanggu and as the trunk line between Hefei and Wuhu. The systems operated reliably and met the practical requirements. In addition, China has also established production lines for 10,000 kilometers of fiber optics per year and for producing 1 ton of quartz per year. A 1.3-micron wavelength semiconductor laser and detectors are in mass production and the life of the device exceeded 100,000 hours. Two thousand program-controlled exchanges are in production and 10,000 units have been qualified by the Testing Bureau.

There have been important advances in biotechnology research. Seven bioengineering drugs have completed intermediate, clinical, or large-scale testing. Genetically engineered hepatitis B surface antigen vaccine has reached the production level of vaccine for 1 million patients. External-use interferon has completed intermediate testing and clinical tests and acquired production certification. Six monoclonal antibody diagnostic reagents have reached international standards and been put into production. Large-scale testing of genetically engineered vaccine for young animal diarrhea has been completed on 100,000 pigs and 1 million young pigs; the vaccine has attained the international standard of similar products. In plant genetic engineering, a batch of transgenetic plants has been obtained. Stability remained to the fifth generation in transgenetic soybeans. A transgenetic rabbit has been successfully raised.

In laser technology, some of the prototype machines have been developed into practical units. Two kW CO_2 lasers are now operating on the production lines. A technical breakthrough has been achieved for 5 kW and 10 kW lasers. Four new models of 100-watt lasers have completed the prototype and component assembly stages. Aviation remote sensing has formed a system that contains signal acquisition, storage, recording, transfer, and processing. Remote sensing was successfully used in producing large-area, large-scale maps of the loess plains, Shanxi and Shaanxi canyons, and Sanbei forest protection zone.

V. Major Breakthroughs in Resource Prospecting Theory and Methods, and New Development in Integrated Utilization of Resources

During the Seventh 5-Year Plan period, the geological conditions and enrichment behavior of petroleum and natural gas were systematically studied. The theoretical basis of natural gas geology was strengthened and new concepts and new explanations were proposed. Verified new reserves of natural gas totaled 299.39 billion cubic meters. Natural gas reserves in Sichuan increased by a factor of 2 to 3. The largest natural gas fields ever discovered on land were discovered in central Shaanxi, Gansu and Ningxia. A highly promising large oil and gas field was confirmed in Tarim basin and Pinghu oil and gas field in Tonghai was verified.

Good results have been obtained in prospecting for nonferrous and noble metal mines. Fifty-one mines of gold, silver, copper, lead, and zinc were newly discovered or expanded into large and medium mines. The good success in nonferrous metal resource exploration in Xinjiang provided a backup base for resources.

In order to improve the ability to utilize resources in an integrated manner, and to change resources into products, a batch of new technologies that suit the particular characteristics of China's mineral mines have been developed. Progress has been made in the semi-industrial testing of the new refining process of pure iron ore at Panzhihua. The vanadium and titanium recovery rate has reached 50-55 percent and 60 percent respectively. The Chinese atomization method for extracting vanadium has undergone continuous improvement. In 1989 the output of vanadium slag reached 75,000 tons or about 80 percent of the total output in China. China has not only satisfied its domestic market for vanadium, but has also become the fourth largest exporter of vanadium. Using a combined reduction and distillation method to replace the interrupted reduction method, the Zunyi titanium plant has increased its production of titanium sponge from 1,000 tons per year to 2,000 tons per year, at an annual profit of 12 million yuan. The Baotou rare earth ore dressing technology has entered industrial production and reached international standards.

VI. Development of New Materials Has Enriched the Market, Improved the Ability To Create Foreign Exchange, and Provided a Basis for Developing New High Technologies

After 5 years of hard work, more than 500 new materials have been developed for integrated circuits, computers, and new components. Domestic production rate for microelectronics has reached 80 percent. Research and production bases for 12 materials for LSIs have been established. Key materials for color TVs have achieved 64.4 percent domestic production. Compared to the Sixth 5-Year Plan period, foreign exchange spent on single machine production material has decreased by 42 percent.

Special steels including 180 types and 1,000 varieties were developed for railroads, automobiles, buildings, engineering machines, energy and petrochemicals. Fifty-four steels have reached foreign standard for similar steels, and 100 have filled a domestic void. Out of the 100, 80 were substitutes for imports and 20 were exported to create foreign exchange.

After achieving some breakthroughs, domestic made color films have partially satisfied the needs in China. In the area of agricultural chemicals, more than 30 low toxicity, low residual pesticides, germicides and herbicides were developed, with 60 million yuan in economic benefit.

To satisfy consumer needs, a batch of new textile manufacture facilities of the 1980s standard and 118 production lines were developed. A dozen pieces of equipment including a high efficiency, high-speed cord bleaching machine and 52 different kinds of coatings were developed. These new facilities have increased China's share of the international textile market and the ability to attract foreign exchange. Through technological development of leather manufacture, the utilization rate of low grade leather has increased from 70 percent to 90 percent. The foreign exchange created by exporting leather products has increased from $360 million in 1985 to $1.67 billion in 1990.

Of the 180 new dyes developed in China, 108 dyes and their additives have been put into industrial production, saving China $40 million per year. The successful development of intermediate products for 38 daily-use chemicals has laid a good foundation for China to develop high grade multi-purpose cleaning products. The mass production of a flame retardant sealant for color TVs has saved China $8 million per year.

VII. Major Advances in Environmental Protection, Pollution Prevention, and Medicine Have Promoted Coordinated Economic and Social Development

Breakthroughs in air pollution prevention have reduced the dust emission of industrial coal by 60 to 80 percent as compared to raw coal; the rate of de-sulphurization has reached 80 percent. New advances have been made in waste water treatment; oxidation ponds have been very effective in land treatment. Investments and energy consumption were respectively only ⅓ and 1/5 that of the usual method.

In the area of natural disaster prevention, a mid-term numerical weather forecast system was established; the system covered the Chang Jiang delta, the Zhu Jiang delta, Beijing, Tianjin, Hebei, and the middle reaches of Chang Jiang. A new batch of atmosphere probing equipment was developed. A more complete, more automated weather monitor and forecast system was established and the forecast ability and accuracy of the various weather bureaus have been improved. These improvements played a role in the flood prevention and disaster relief in the extraordinarily large and sustained rain storm in 1991. One to three ocean environment numerical forecast systems were established and the forecast accuracy has reached that of the mid-1980s international standards.

In the area of nuclear safety, a system of nuclear safety regulations has basically been formed. Key monitoring technology and emergency handling technology are in hand. This has formed a basis for ensuring safety in nuclear energy development.

Important advances have also been made in the area of major diseases and malignant tumors. Research in attenuation live vaccine for hepatitis A has led to the successful selective cultivation of the H_2 strain. Three human inoculation sessions have involved 10,000 people. In large area clinical experiments, the antibody positive conversion rate has exceeded 90 percent. Small batch production has begun and vaccines for 200,000 people have been prepared. Vaccine testing methods and standards have also been established, which put China in the leading position. New technique of selective targeted treatment of liver cancer was tried in clinical tests for the first time and satisfactory results were obtained. This new approach in liver cancer treatment has attracted the attention of the medical community here and abroad. Research has also produced results in new birth control drugs, medical devices, and the use of Chinese medicine; some new products have been developed. Quality evaluation standards for 120 Chinese medicines have been completed.

VIII. The Development of Fundamental Research Gave Research Lasting Power

During the Seventh 5-Year Plan period, a total of 1,339 experimental production lines, 872 industrial testing bases, 2,513 agricultural and forestry testing points and bases, 42 data banks, and one national agricultural seed resource center were built. This has strengthened the material basis for science and technology breakthroughs. The national agricultural seed resource center handles more than 200 types of seeds each day and has a total capacity of 400,000 specimens. The coal resource center stored coal data for China's major coal production regions and coal mine geological data. Also stored were data on coal quality, changes in coal production, burning and conversion of typical coals, standard coal specimens, distribution of trace elements in coal and petrographical analysis data.

Extensive work has been done in the fundamental study of environmental background values. Soil background value studies were completed in 30 provinces, municipalities, and autonomous regions for 41 soil types. Background values were obtained for 13 elements in 4,000 cross-sections and 48 elements in 800 cross-sections. Background values were also collected for water, precipitants, and aqueous biology at 400 sampling points of the Chang Jiang water system.

Internationalization of High-Tech Industry Discussed

92FE0155F Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 14 Oct 91 p 3

[Article by Yan Xingen [0917 2450 2704] and Chen Youliang [7115 0645 5328]: "On the Internationalization of High-Tech Industry"]

[Text] Allowing China's high-tech industry to move toward the world and achieving the internationalization of its production and management are new topics that China's high-tech industry faces after entering the 1990's as well as an inevitable trend in the future development of China's high-tech industry.

I.

S&T progress and the intensification of international competition are now accelerating the global processes of the world economy. To strengthen their own competitiveness and fight for high-tech world markets, growing numbers of high-tech enterprises in foreign countries are crossing national boundaries to make direct investments, expanding enterprise coalitions, establishing research organs in foreign countries, and engaging in a variety of forms of cooperation with scientific research organs and institutions of higher education in foreign countries. This trend toward internationalization of high-tech enterprises in foreign countries is a concentrated reflection of the characteristics of the globalization of the world's high-tech markets and the internationalization of production, and it embodies the new trend of close integration of S&T with the economy.

Internationalization is an important characteristic of high-tech industry. The primary sources of technology, parts and components supplies, and markets for high-tech industry are international. Practice in China over the past several years has proven that for high-tech industry, there is domestic competition as well as international competition behind it. Thus, the development of high-tech industry must certainly orient toward the international market and strive for optimum combinations of the factors of production on an international scale, and the objective of product technology indices and performance/price ratios should be competition in the international market. Internationalization is the way out and lifeblood in developing high-tech industry.

II.

Although China's high-tech industry got started rather late, China's high-tech industry already basically has the conditions and potential for moving toward internationalization.

Over the past 40 years, we have established high-tech achievements and industries including aviation, space, nuclear energy, microelectronics and computers, biotechnology, optoelectronics and communications engineering, marine development, new materials, automation, precision instruments, and other industries.

We have established and are now forming several high-tech enterprises and enterprise groups on a definite scale and many high-tech products have entered the international market.

Since reform and opening up, scientific research organs and institutions of higher education have discussed arrangements and routes for converting high and new-tech achievements into forces of production and carried out highly effective explorations that include the transfer of S&T achievements to local areas and enterprises via contracts, the establishment of high and new-tech development zones in conjunction with local areas, creating knowledge- intensive and technology-intensive high-tech enterprises, and so on. These successful practices have now revealed their vital force in national economic construction and have produced substantial economic benefits.

However, China's high-tech industry still faces many difficulties and challenges in moving toward the world.

In the international arena, the internationalization of China's high-tech industry faces more intense competition. On the one hand, due to the slow growth of the world economy, growth rates of international trade have declined, which has caused an intensification of competition to expand exports. From 1955 to 1973, the average annual growth rate of world GNP was 4.5 percent and the average annual growth rate of world trade was 7.5 percent. From 1973 to 1984, the average annual growth rate of world GNP was just 2.8 percent and the average annual growth rate of world trade was only 3.3 percent. Forecasts indicate that from the 1990's to the end of this century, the average annual growth rate of the world economy may only reach about 3 percent and the average annual growth rate of world trade will also be just 3 to 4 percent, which is still a low rate of growth. In a situation of limited market capacity in international trade, the development of internationalization of China's high-tech industry also faces challenges from newly emerging industrialized nations and regions and it faces competition from enterprises in other developing countries. There are growing numbers of competitors and the fight for export markets is becoming fiercer.

In another area, trade protectionism is now rampant in the Western industrially developed nations and there are growing numbers of trade barriers. According to statistics from the World Bank, the proportion of exports to the United States and European Community that were subject to tariff restrictions increased by more than 200 percent between 1981 and 1986. The intensification of trade friction among the developed countries has strengthened trade protectionism. On top of tariff barriers, which were already very solid, they have also built non-tariff barriers like quota systems, import licenses,

packaging regulations, safety standards, complicated customs procedures, and so on. New trade protection methods like monetary devaluation wars, and so on have also appeared in the past several years. The restrictions encountered by exports of finished products from developing countries often far exceed those of the developed nations. There are also certain restrictions on high-tech flows by the Western developed capitalist countries toward socialist countries, and so on. All these things severely obstruct the development of China's high-tech industry internationalization.

Regarding the domestic situation, these are the main problems and difficulties that exist:

1. It is common for China's high-tech enterprises to lack a consciousness of international management and international markets and lack a concept of international competition, and there is a substantial "drop" in the ideology and concepts, psychological qualities, and technical levels of enterprise cadres and employees relative to the overall trend of enterprises developing an export-oriented economy, moving toward the world, and participating in global competition. In this type of situation, even if we had more capital, more advanced equipment, and better products, it would still be hard to attain success in internationalized management.

2. Information is inaccessible, import and export channels are narrow. Broad information network, global marketing, and other systems are common characteristics of developed countries and large enterprises. Nevertheless, China's foreign trade enterprises still lack market research departments and are unable to provide timely international market information to production enterprises. Few of China's high-tech enterprises have established information organs or specialized functional systems capable of immediately organizing supply and marketing services in foreign countries. Most import/export services involve using foreign trade departments or intermediary agents and there are few contacts with customers and consumers. There is little understanding of international markets and they are often in a passive situation.

3. We lack flexible and effective risk investment mechanisms. One defect of the traditional system is an inability to rapidly and effectively convert S&T achievements into commodities to generate economic benefits. This situation is especially apparent in emerging industry departments based on high-tech. Insufficient capital is another impediment to the conversion of technical achievements into social products. Banks usually provide loans only to projects and enterprises which have guarantees, so it is very hard to make a decision to support production experiments for many high-tech but risky projects. For scientific research units, many of the scientific research projects for which intermediate testing and operationalization experiments have been conducted involve medium-sized and small new technology projects with market shortages and economic benefits but which also involve risk. They become "nobody's business" because there is no funding support or loans and cannot be developed.

III.

If China's high-tech industry is to move toward the world and establish itself on the world's economic stage, we must continually open up international markets. We feel that the strategy for internationalization of China's high- tech industry should be a strategy with the objective of establishing international high-tech enterprise groups (multinational corporations) and entering the central zone of world high-tech.

The reason for this is that the essence of high-tech industry determines that backward countries can use "late development benefits" to implement transcendent development. Thus, development of the internationalization of high-tech industry can make breakthroughs not from the periphery but from the center. At present, the world's high-tech market has formed a configuration with the United States, Western Europe, and Japan at the center and emerging industrializing nations or regions around the periphery. These countries are the center of the network of world circulation channels for personnel, information, and resources. The primary markets, major competition, and main technologies are all located there. China's high-tech enterprises should surely utilize or rely on these countries or regions to promote high- and new-tech commercialization and industrialization and grasp the pulse of world economic development. On this foundation, consideration can also be given to the market for high-tech products in the Third World. For this reason, we should promote the development of industrialization of China's high-tech industry in the following areas:

1. The export-oriented development of China's high-tech industry should have the world market as its objective, seek out all opportunities in every link of research, development, manufacturing, marketing, and services, strive for integration with industries in the United States, Japan, and Western Europe, combine hardware and software exports, and gradually develop our companies into foreign countries and toward multinational corporations. Analysis from the marketing perspective shows two characteristics for the world's technical software market: First, there are differences in any market and the technical software markets in each country have different requirements. In the developing countries, for example, overall technical levels are rather low, so overall there is relatively greater demand for advanced technology. Overall technical levels in the developed countries are relatively high but this does not mean that they hold an absolute advantage in every technology and there may still be some demand in certain technical fields and links. Second, the advanced qualities of technical software are relative. A certain technology that may be considered backward in one country might be advanced in another one. Given the existence of these differences, China can use its own high-tech and unique

technology (such as secret Chinese medicine preparations) for direct overseas investment, and we can use advanced technology that we have digested after importing and timely purchases of advanced technology to invest and establish enterprises in foreign countries to attain our objective of opening up international markets. Enterprises should try as much as possible to establish high-tech companies in developed countries as this would provide several beneficial conditions: 1) We could borrow from the extremely mature and highly efficient operational mechanisms of the West to do things that we cannot do within China under the existing S&T system. 2) Many developed countries are the world's primary markets for high-tech products and their plants and enterprises have powerful purchasing abilities, so establishing companies in these countries can enable us to perfect and improve product quality (including external appearance) based on their product requirements. At present, several of our products just barely fall below the requirements of international markets, but because our companies are not in foreign countries, feedback information is slow in coming, so we cannot reduce our lag even with tremendous effort. 3) Establishing high-tech companies in foreign countries can absorb Chinese students and personnel in foreign countries to work in the companies. China now has many Masters' and Ph.D. students in the United States and other developed nations and many are involved in high-tech research. We could attract them into companies to play a role and serve the motherland.

2. Gradually establish and perfect an external environment suitable for China's high-tech industry to move toward internationalization. Giving high- tech enterprises having the proper conditions the status of legal persons, negotiating rights, contract signing rights, foreign exchange conversion rights, foreign exchange retention and utilization rights, and so on in engaging in administrative activities with foreign countries can enable them to engage in all types of administrative activities and technological exchanges and cooperation with international plants and businesses in accordance with international practices. In addition, they could establish rather broad-ranging technical and economic relationships with international plants and businesses, establish the required market conditions, sales, and technical service network points, and establish close relationships with marketing organs in China and foreign countries.

3. Establish risk capital, use it to support enterprises that produce in foreign countries and at the same time assist enterprises in seeking out banks or other financial organizations to serve as backup forces, and organize industry financing by people in the same boat helping other. In another area, given China's capital problems, especially in regard to foreign exchange, we propose that China's high-tech achievements be taken to development zones in foreign countries, that S&T achievements be used to establish companies, and that S&T achievements attract foreign exchange investments to take full advantage of risk investment activities in other developed countries of the world.

4. Accelerate the training of personnel for internationalization, enable enterprises to adapt to the requirements of international practices. Allow personnel involved in administrative activities with foreign countries who understand technology, understand production, understand trade, and understand international business methods to become proficient in one or more foreign languages. Moreover, we should also train and form technical personnel who understand specialized knowledge in their fields and who have real operating capabilities and who can gain a grasp of foreign languages to immediately go to foreign countries and provide technical services to users.

Looking at the current situation in China's high-tech industry development zones, there are still just a few that have the basic conditions for developing internationalization. Thus, we should conscientiously select a few high-tech enterprises with good conditions, comprehensively provide them with training and support, and send them to inspect international markets to serve as a breakthrough point for internationalization of China's high-tech industry and enable it to develop in a rolling manner.

Stone Group Probing Ways To Internationalize High and New-Tech Industries

92FE0215G Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 27 Nov 91 p 4

[Article by Duan Yongji [3008 3057 1015] of the Beijing Stone Group Corporation: "Striving To Explore Routes for Internationalization of High and New-Tech Enterprises"]

[Text] Competition in international markets is now becoming hotter and hotter and the trend toward regional economic integration is becoming stronger. Trade barriers in the developed countries are becoming increasingly serious and the gap in the proportions of high-tech product markets that are controlled by the developed countries and the underdeveloped countries is growing. Developing multinational businesses in this type of international economic environment is an extremely difficult topic for a developing country like China with our capital shortages, relatively backward technology, and inadequate management experience, especially given our weak ability to open up international markets. Models for multinational enterprises can be divided into three main categories. Category 1 is industrial enterprise groups with similar technological strengths and economic capabilities. Category 2 is trade companies with rather powerful international business capabilities. Category 3 is banking and financial enterprises with powerful capital strengths. Thus, when selecting its industrialization strategy and designing its multinational business model, each enterprise must

clearly recognize its own position, foster its own advantages, and select an optimum route.

The second year after the Stone Company was founded, we suggested making a "Chinese IBM". This did not mean that we wanted to make a Chinese subsidiary of IBM but instead that we wanted to make Stone an IBM-type enterprise. This means achieving product commercialization, commodity industrialization, and industrial internationalization in the high-tech field to explore a new route for achieving internationalized management to develop China's high-tech industry. For more than 7 years and after several twists and turns and several readjustments, while perfecting ourselves and continually going all out, we have attained a relatively high development speed and laid a definite foundation for internationalized management. There are several points to our ideas and understandings:

I. Complete Enterprise Mechanisms Are the Foundation for Achieving Internationalization

For an industrial enterprise to attack international markets and achieve a multinational management strategy, it must have the proper conditions in areas like skilled personnel, mechanisms, management, technology, capital, production capabilities, and so on. However, the most basic and important condition should be the issue of the internal structure and operational mechanisms of an enterprise. They affect the qualified personnel structure, management patterns, and operational efficiency of enterprises, and they reflect the degree of standardization and degree of safety of enterprises. Thus, perfection of enterprise group management models and shareholder enterprise mechanisms along with achieving standardized enterprise management are directly related to enterprise progress in internationalization.

A. Perfect an enterprise group model that integrates technology, industry, trade, finance, and services

Stone Company was established in 1984 and was expanded into a group company in 1986. Based on the international experience of high-tech enterprises, we feel that integrating technology (science), industry, trade, finance, and services is the basic model for industrial enterprise groups. In the 5 years since the Stone Group was established, we have pursued the largest scale of management, achieved an 80 percent market dominance rate for primary products, formed a selling and service network with national coverage, established development and production base areas with primary products as the tap, established our own banking and finance company, completed construction of a beachhead in foreign countries, and gradually formed a relatively perfect enterprise group with polyhedral management that integrates technology, industry, trade, finance, and services that has laid an excellent foundation for starting our course toward internationalization.

B. Implement a standardized management model

Standardized management is a fundamental guarantee of good enterprise operation as well as capital construction for a multinational company. While making structural readjustments, Stone has also proposed the slogan of management efficiency, management image, and management results. Through four major readjustments over the past several years, we have gradually formed a standardized management model centered on functionalization, proceduralization, and systemization to make enterprise behavior conform to internationally accepted practices, continually perfect its own quality, and achieve systematic guarantees of enterprise objectives.

C. Explore operational mechanisms of the shareholder system

We began putting together a shareholder system program in 1988 and after receiving approval from the State System Reform Commission in 1989, we formally established the Stone New-Tech Industry Company, Ltd. Because of a lack of matching macro policies, however, the original plan to issue 25 million yuan in shares to foreign countries and society could not be implemented. However, in a situation in which the macro conditions were not ready, we tried when we were establishing the new enterprise to base it on standardization of mechanisms and property rights relationships and formulated four principles:

1. The group must have shareholder control of marketing subsidiary companies.

2. Joint Chinese-foreign investment must be the dominant factor in industrial enterprises, so actually they are limited share companies.

3. Enterprises in foreign countries must implement shareholding according to international practices.

4. Actively explore implementation routes and methods for shareholding for the group, try to clearly demarcate the property rights of enterprise from top to bottom, and establish standardized enterprise responsibility and rights relationships.

II. Fighting for Superiority in a High-Tech Environment

The characteristics of world technology trade show that overall technical levels in different countries and regions form a slanted gradient in technology markets. This means that the developed countries are the primary source of advanced technology and high-tech products, while the discrepancy of technical levels in underdeveloped nations continues to grow. The result is that underdeveloped nations can only place themselves at the lowest levels of the world technology market gradient and can only supply the market with products that contain no technical added value or a minimum amount of technical added value. At the same time, however, we also noted the creation of "latecomer advantages" in

high-tech development in which enterprises with relatively backward technology use permeation of technology-intensive regions and cooperation among enterprises in developed and underdeveloped countries to enable themselves to jump over a step in the "technology gradient". Thus, to win latecomer advantages in high-tech, we must place ourselves in a high-tech environment or in the main channel of high-tech information flows before we can develop our own high-tech industry and gain the qualifications and opportunities for participation in international market competition.

The Stone Company is a new type of high-tech enterprise. To move up into the international high-tech market, we mainly adopted the following measures:

A. Persisting in international cooperation with first-rank enterprises

Cooperation with first-rank enterprises can rather directly enable us to understand technical information on products and the technology and measures for development and production as well as allow us to study their advanced management experiences and patterns of international market operation. Moreover, the success rate in cooperation was rather high.

B. Establishing product development centers in foreign countries

One obvious characteristic of high-tech products is that intense competition is making product production schedules increasingly shorter.

This requires us to have flexible information and fast response, new designs and low costs, and high technological levels.

To catch up with and surpass world levels from a high starting point, another route is establishing development base areas in foreign countries.

Stone Company's first product development center was in Hong Kong and the second was in Australia. We are now preparing to build a joint investment software development organization in Japan and we are preparing to establish our own product development organization in the United States. Practice has proven that establishing development base areas in foreign countries has these advantages:

1. They can directly utilize information resources in foreign countries and open up development ideas.

2. They can effectively utilize a development environment and accelerate the pace of development.

3. They can use advanced technology and intermediate products from foreign countries to reduce the lag behind international markets.

4. They can absorb qualified international personnel and accelerate the pace of entry into international markets. Of course, considering the production costs in foreign countries and effective utilization of China's resources, we should gradually establish matching production base areas in China and truly form a configuration with two heads in foreign countries and the middle in China.

Studying high-tech, grasping high-tech, and applying high-tech in a high- tech environment and thereby participating in high-tech product competition is the goal we are diligently striving for as well as one route for achieving internationalization of Stone. Of course, there are several methods at even deeper levels, for example local development and local production according to market objectives. This method is used by many multinational companies and we should continue to explore it.

III. To Have High Starting Points, We Must Adopt a Leap-Type Development Model

Although we have made considerable progress over the past several years, China's high-tech industry still lags substantially behind the developed countries. For the information industry, computer technology, and microelectronics, some estimate that we lag at least 15 to 20 years behind, but this is looking backward. How about looking ahead? Our path in the future will also be extremely rough. To overcome the bumpy obstacles and take fewer detours, we must adopt a leap-type development model. If we do not learn how to leap and merely imitate someone at every step, we fill fall even further behind.

We proposed a leap-type model in 1991 and conducted explorations in these areas:

A. Skilled personnel for internationalization must be based on local talent

If Stone can be said to be successful in the area of the domestic market, summarizing our basic experiences in success indicates that it was done by attracting, forging, and training a large group of skilled personnel appropriate for company development. Still, if we want to open up international markets and achieve the objective of enterprise internationalization, the quality, structure, and experience of our personnel are all obviously inadequate. Although selection and training are essential, it will take too long and we lack the conditions and environment. Thus, we must base ourselves on exploiting local talent.

B. The establishment of enterprises in foreign countries should involve mergers or purchases

In the past, we had another model, which was that it was best for enterprises to do things themselves, moving from small to large and leaving a footprint at each step. Certainly, Stone developed this way in China. However, this type of model severely obstructs polyhedral and deep-level enterprise development, especially when establishing enterprises in foreign countries, where there are cultural differences, technological differences, and market environment differences. Moreover, there are restrictions in certain areas that prevent us from

achieving our goals. As a result, we started in the last half of 1990 to study the models and methods of several large multinational companies on the international scene, and we feel that mergers or purchases are one route. It was at exactly that time that the enterprise in Australia with which we had been cooperating began developing a rather technologically advanced multiuser system, but the company had a shortage of capital and was unable to place it into scale production. Through bilateral negotiations, a formal agreement was reached in early 1991 in which Stone invested 75 percent of the capital and gained shareholder control of the company. The enterprise also changed its name to the "Australia Stone Company" at that time. With the exception of the assistant general manager and a chief financial administrator that were sent from Stone, all of the remaining skilled personnel were recruited locally.

The Australia Stone model did not just provide us with a product that we developed and produced in a foreign country and that truly entered the international market. It also gave us experience in developing industries in foreign countries and achieving internationalized management.

C. Product production should borrow from the OEM model

In carefully analyzing industrial deployments in the developed countries with relatively perfect market mechanisms, relatively rational industrial deployments, and increasingly detailed industrial division of labor, we may discover that most products and not all components were produced by the plants which make the primary equipment themselves. Most employ a coordinated production or commissioned processing OEM model. This is the case for IBM, Hitachi, and Fujitsu computers as well as for Toyota automobiles and Honda and Yamaha motorcycles. Their integration, coordination, division of labor, and cooperation of this sort was formed naturally under market mechanisms and their operational patterns are becoming increasingly common and perfected. China is a country at a relatively low level on the technology gradient. On the one hand, we have no incisive technological advantages and our production equipment and management measures are relatively backward. If we rely entirely on ourselves from the very beginning for a whole high-tech product, they will inevitably be fewer, slower, poorer, and more costly. On the other hand, we have many intellectual advantages and rather high levels of processing capabilities for several basic products or components, so why don't we take advantage of them? Thus, using other people's OEM components to produce our own product systems or using other people's complete unit products for coordination with OEM are both excellent routes for us to enter international markets as well as a standard international practice. In the past, Stone was developed in this way and we should borrow from this model in the future to open up international markets. Moreover, we have even greater hope that we can form this sort of coordinated and cooperative configuration within China.

IV. Coordination of Domestic Policies Is an Essential Condition for Achieving the Goal of Multinational Administration

Achieving multinational administration is the development direction of Chinese enterprises. Moreover, state support and assistance to enterprises in achieving enterprise internationalization is an important national policy for developing China's export-oriented economy. The Stone Company is like many enterprises in China. They have a common goal, which is to enable Chinese technology, Chinese products, and Chinese capital to gain its own share in international markets. Thus, we must discuss and formulate the corresponding matching policies concerning the issue of enterprise multinational administration in order to support, encourage, and assist enterprises in developing toward internationalization.

1. On the question of multiple industry, multiple region, and multiple ownership system integration

For the past year or more, because of product technology and market competition requirements, many large and medium-sized high-tech enterprises internationally have merged and recombined. In the electronics and information industry, for example, the integrated body led by IBM and the Apple Corporation and the ACE group represented by Compaq and Microsoft have gained decisive advantages in entirely different ways. The basic model for most multinational enterprise combinations for Japanese enterprises is to be headed by businesses like Mitsui, Mitsubishi, C. Itoh, and so on, to form competitive mechanisms. This type of integrated body combines advantages in dividing technology, products, information, and markets. They have revealed powerful market competitiveness and economic power and have formed a market monopoly situation at even higher levels. The Stone Company has sought cooperation with large plants in similar industries on many occasions, but because of conceptual and system reasons we were unable to make any progress. Thus, we should study how we can spur enterprises to achieve multiple ownership system, multi-sector, multi-industry, and multi-region integration to form excellent cycles for enterprises that have small burdens, little resistance, rapid steps, and good results.

2. On the question of industrial management

Industrial management should involve management via policies, laws, and regulations and should involve management on the basis of industries, products, and market jurisdictions. When implementing industrial management, we should break through certain boundaries to help foster overall advantages, develop China's high-tech industry, and promote internationalization of high-tech enterprises.

3. On the question of foreign exchange management

This is an important topic that enterprises like ours have encountered during development. We feel that there should be a positive relationship between the degree of

internationalization of an enterprise and the extent of freedom for its capital and for its personnel to go abroad.

4. On the question of the shareholding system and securities trade markets

We feel that using a standardized shareholding system model to establish multinational enterprises or enterprise groups and to establish and perfect securities trade markets is an effective way to perfect the internal mechanisms of multinational enterprises, reinforce enterprise management and administration, provide enterprises with development capital, and increase the recognition of enterprises.

Understanding High-Tech Industry Urged

92FE0155B Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 15 Oct 91 p 2

[Article by Li Guanglin [2621 0342 5259], director of the National Natural Sciences Foundation Policy Bureau: "Some Points of Understanding on Industrialization of High Technology"]

[Text] Abstract: The formulation of high-tech industrialization strategies must select and focus on those fields which are most capable of earning profits and use the most economical arrangements to make investments. It cannot simply set the levels according to how high or low a technology is in accepting or rejecting them. Basic high-tech enterprises and development and application-type high-tech enterprises are the two legs of China's high-tech industrialization and neither of them is dispensable.

The development of high-tech must achieve industrialization if it is to attain the ultimate objective of high-tech development and truly play its role in spurring economic and social development. However, there are still several basic problems in understandings of how to achieve the industrialization of high-tech R&D achievements that await resolution.

I. The Basic Economic Principle of High-Tech Industrialization Must Be Increasing Our National Strengths

There are many categories of high-tech and differences in characteristics and roles, and there are substantial differences in the effects of the conditions, processes and results of industrialization on economic and social development. As a developing nation and under conditions of extreme shortages of resources and fierce international competition, we cannot develop everything, so we must make hard but important choices. With the exception of national defense and other fields with special needs, in the overall sense we must adhere to the basic principle of maximum economic benefits as the optimum choice when formulating high-tech industrialization strategies and adhere to the principle of focusing on economic development, focusing on research, development, and industries that truly help strengthen our national strengths and deal with concrete matters relating to work, selecting those fields most capable of earning profits as the main factor, using the most economical arrangements to make investments, and not simply using whether a technology is high or low to set levels and make choices on acceptance or rejection.

As a big socialist country, China must make a decision to lay an excellent foundation in basic general-purpose technical and industrial areas, and occupy its necessary international status. This is a political requirement as well as a requirement for stable economic development. For example, microelectronics and optoelectronics are not just the foundation of all modern electronics technology but are also the foundation of modern S&T, industrial, national defense, economic, and social development. We should give preference to these fields and make inspections and programs from the state's basic interests.

In a developing nation like China, it is absolutely essential that a small number of people work on basic scientific research and track several high technologies. However, most crack forces should be used to develop the economy and high-tech R&D that directly serves economic development. Shifting most first-rate key technical cadres to departments with economic benefits and high-tech industrialization work may temporarily permit several positions at the vanguard of technology, but on a foundation of rapid economic growth it may ultimately recall even more.

The high-tech industry plan decided upon on the basis of the principles described above should be used to inspect high-tech development plans. Some fields should limit their objectives to the range of focusing closely on international trends and reduce investments. Many fields should limit their objectives to tracking the dynamics of key technologies and reduce investments as appropriate. Some fields should make their objectives more practical or make industrialization their direct objective, increase investments, and accelerate the pace.

II. The Process of Industrializing High-Tech Achievements Is a New Take- Off in Technological Development

The high-tech achievement industrialization process is not the same as the R&D stage. During this process of integrating technology and the market, S&T entrepreneurs should occupy a central status. The discovery of new technical measures and methods is an application of technical R&D achievements and the starting point for a large-scale industrial revolution. At the same time, growing numbers of people are understanding that the development of R&D achievements into large-scale applied industrial technology requires secondary development and several 10 times the investment as well as specific environmental supporting conditions and a

rather long time. In addition, it involves facing substantial market risks and in many situations there are few opportunities for success and the possibility of failure exists.

However, another basic question of understanding that most requires solution at present is that in the R&D stage and industrialization stage, different dynamic factors in technical development determine that the two stages must have different operational mechanisms. In the R&D stage, the inherent propulsive force in technical development is the primary dynamic factor and the management system of laboratories and research institutes must be adopted to handle matters according to the laws of technical development. During the industrialization stage, market traction is the primary dynamic factor and matters should be handled mainly according to market laws. Of course, it is hard to absolutely separate the two stages and at certain intermediate links the two types of roles often repeatedly occupy the primary status, so things are extremely complex.

In the high-tech industrialization process, the four basic factors of technology, capital, markets, and management play a role and it is a process in which managers use capital to integrate technology and markets. Technology requires secondary development, markets must be opened, and capital must be raised. Thus, during the high-tech industry formation process, managers, who are S&T entrepreneurs, occupy the central status. Only by letting go and relying on S&T entrepreneurs, guaranteeing their interests and rights, and making them use capital most effectively can high-tech industry be established most quickly. The operational mechanisms of high-tech industrialization must observe the requirements of this objective law.

III. Accelerating the Course of High-Tech Industrialization Requires Full Utilization of International Resources

Mutual study, exchange, and supplementation are now essential conditions for high-tech development. There is not a single country that can separate itself from international society and sustain healthy development of S&T and its economy. The technology, capital, markets, and management required for high- tech industrialization are international resources and those who seize opportunities are those who can make full use of them and more quickly develop their national economy and produce benefits for that country's people.

Joint investment and joint ventures are important ways to raise capital, import advanced management methods from foreign countries, and open up international markets, while importing technology is a reasonable way to establish industry more quickly. Developing nations have a relatively weak technological and industrial foundation. In the series of technologies required for high-tech industry, for S&T personnel in all countries there is a large proportion of immature technologies, so if they rely entirely upon their own development to obtain them, the time required will be rather long. It is also precisely for this reason that for a single technology, imported achievements would appear to be higher but in terms of overall benefits, going into operation quickly and the small risk involved is economically rational.

The importing, digestion, and absorption of technology for high-tech industry requires a high-level fully outfitted R&D technical group. S&T personnel involved in importing should be a group that is matched up with the technology required and not just individual experts. To find a space and status for their own existence in an open system, they must rely on their own efforts and use their own strengths to engage in cooperation and exchanges with foreign countries. China's process in utilizing international resources to establish high-tech industry is a process in which China relied on its own efforts to adapt to and utilize the international environment.

IV. The Two Different Types of High-Tech Industry Are the Two Legs of China's High-Tech Industrialization

In regular civilian high-tech enterprises, because of differences in technical characteristics and market demand, under China's social conditions, they can be divided overall into basic high-tech enterprises and development and application-type high-tech enterprises. These two types of enterprises play different roles and have different operational mechanisms, but they are the two legs of China's high-tech industrialization and neither is dispensable.

Basic high-tech enterprises must be deployed at fixed sites by the state in a planned manner, with administrations or departments participating in guiding administration. When conditions permit, they should be given technical responsibilities by research institutes in industrial departments and try as much as possible to make joint investments and joint ventures with large corporations in foreign countries to form forces of production immediately. In this way, they can satisfy demand in the domestic market and create new high starting points for continued domestic R&D.

Typical examples of development and application-type high-tech enterprises include those run by the Chinese Academy of Sciences and institutions of higher education at Zhongguancun and medium-sized and small S&T enterprises that have been established in all areas of China as well as certain civilian-run S&T enterprises established by engineering and technical personnel. This category of enterprises must be centered on entrepreneurs, use the market as a guide, implement the most flexible civilian-run enterprise operational mechanisms, and participate in market cooperation and competition. The state should make the development of this category of enterprises an indispensable aspect of high-tech industrialization. They are the locus of the interests of the state and should receive resolute support in areas like taxation, risk investments, loans, tariffs, and so on, create the environmental conditions for them to serve as

incubators and industrial parks, continually encourage large numbers of S&T personnel to establish and participate in this category of enterprises, and truly guarantee their political and economic interests.

Basic industry is small in number but has a substantial impact, and it is the pillar for developing high-tech industry. Development and application-type industry is small in scale but large in number and comes in many forms. It is a primary route for satisfying economic and social demand, an important form for integrating R&D with the market, and an important pattern for developing high-tech and high-tech industry. Neither of the two is dispensable and they are mutually complementary.

Song Jian's "High-Tech Strategy"

92FE0155G Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 16 Oct 91 p 1

[Article by Song Jian [1345 0256]: "Preface to 'High-Tech Strategy'"]

[Text] Since the 1960's, the tide of high- and new-tech development has lashed like an irresistible trend upon all aspects of human society. A large number of gradually forming high-tech colonies like information technology, biotechnology, new materials technology, new energy resource technology, space technology, marine development technology, and so on have and continue to speedily permeate all realms of economic, military, and social life, and they are developing at an unprecedented scale and pace and rapidly being converted into forces of production, requiring pioneers to have much greater material wealth and spiritual strength than in any other era. This new technological revolution is a terrifying force, an enormous role, and intense rivalry, and has profound effects, all of which are incomparable to the various technological revolutions of the past. It can truly be called a global "world technology war" and is a rigorous challenge for all countries.

Marx said over 100 years ago that science is "a revolutionary force in the highest sense". He also pointed that out "social labor forces of production are first of all scientific forces". Looking over the modern S&T history of mankind, each major scientific discovery and technological innovation has created a leap in people's understandings of the objective world. The rising tide of each technological revolution has raised people's abilities to transform nature and the forces promoting social development to an entirely new level. The development of high S&T during the last half of the 20th Century has provided more confirmation than in any other period in the past that modern science and technology are the first force of production and a powerful driving force for major military fighting strength and social progress.

Since entering the 1980's, in the fight for "commanding elevations" in economic and S&T development to gain a more favorable position in this new historical era, many countries in the world are making readjustments in their national development strategies and studying and formulating high-tech development programs based on situation developments and concrete conditions in their own countries. Many are developing high-tech as a strategic focus and key measure for invigorating their nations and strengthening their armies in order to increase their comprehensive national strengths. The essence of competition of comprehensive national strengths is S&T competition. Increasingly, competition of economic and national defense strengths is manifested as competition of technical levels that are materialized in commodities and national defense equipment. Modern warfare has now become a high-tech measure of strength. Comrade Deng Xiaoping has pointed out that "high-tech developments and achievements are a reflection of the capabilities of a nation and a nationality as well as an indicator of a nation's prosperity and development". Modern S&T in developing the social forces of production of a nation has become the most important supporting force. In the early part of the 20th Century, S&T progress factors as a proportion of the growth in GNP in several industrialized developed countries was just 5 to 20 percent. They had risen to about 50 percent by the 1950's and 1960's and to as much as 60 to 80 percent by the 1980's. This shows that the development of S&T has a prominent strategic status in improving comprehensive national strengths. The facts once again prove that in this "war" to increase comprehensive national strengths, whoever is able to seize the "commanding elevations" and "forward positions" can become more politically independent, more economically prosperous, more powerful militarily, and more active strategically and take their place among all nationalities of the world.

The key factor in developing S&T is fostering the role of skilled S&T personnel. In the final analysis, economic competition, military competition, and S&T competition are competition of skilled personnel. Training a large colony of high-quality skilled personnel has become one of the main objectives in every country's high-tech development strategy.

In this high tide of the new technological revolution, China was also one of the countries that got started relatively early. Before 1949, S&T in China, a magnificent nation with a population of 400 million, was weak and unable to stand on its own. In 1956, with the coming of a high tide of economic construction, the CPC Central Committee called on all the people of China to "advance toward science". Immediately thereafter, the State Council established the Science Planning Commission and organized more than 600 scientists and technical experts from throughout China to formulate China's first 12-year S&T development program, drafted the first group of important development plans including basic research, applied research, and development research, and adopted six urgent measures to develop computing technology, semiconductor technology, automation technology, radio technology, nuclear technology, and jet technology. From this point, fundamental changes took place in China's S&T activities and they began moving

toward the route of modernization. At that time, China had just been liberated, economic construction had just gotten underway, our economic strengths were very weak, we were blockaded by imperialism, and there were the subsequent 3 years of difficulty. However, we firmly relied on the staunch leadership of the CPC and the superiority of the socialist system and with a powerful and dauntless revolutionary spirit organized manpower and material forces, made major efforts at coordination, and completed the "two bombs and one satellite" [atomic and hydrogen bombs, artificial satellite]. Compared to foreign countries, China spent just 2 years and 8 months from its first atomic bomb to the successful detonation of its first hydrogen bomb, while the Soviet Union took 4 years, the United States 7 years, and France 8 years. The launch of China's first satellite came just 13 years after the time the first satellite in the world was launched. The successful development of the "two bombs and one satellite" not only raised China's international status but also spurred the establishment and development of high-tech industry in China. In 1986, China formulated the "863" high-tech R&D plan, which is precisely for the purpose of further tracking world high S&T developments, meaning the development of tomorrow's technology, and for guiding today's technical progress, promoting the flow of high-tech into traditional industry, and spurring technical upgrading in traditional industry. High-tech is bringing renewal to traditional industry and the new tide is spurring common prosperity in large and medium-sized enterprises. Rapidly converting S&T achievements into forces of production and achieving industrialization and commercialization are key measures for invigorating China's economy, national defense, and S&T, increasing our comprehensive national strengths, and reducing our lag behind the developed nations. For the past few years, implementation of the "863" Plan and the "Torch Plan" to promote the development of high- and new-tech industry have made initial achievements, but we still lag substantially behind foreign countries in many high-tech realms. On the basis of absorption, digestion, and continuation, we should strive to promote the development of high-tech industry and economic construction, strive for substantial advances in the high-tech area, try to create more competitive high-tech, new products, and new equipment, and strive to enter the international stage.

S&T are the common wealth of all of mankind. We must earnestly study and borrow from successful experiences in developing high-tech in foreign countries, use them for ourselves, and push China's "four modernizations drive" to a new height. Training skilled personnel also includes popularization and raising the levels of consciousness and knowledge of all our nationality concerning high-tech. A comprehensive introduction, study, and research of the history, characteristics, and experiences, and lessons of high-tech development in China and foreign countries is extremely important. With the happy news of the coming publication of the book GAO JISHU ZHANLUE [High-Tech Strategy], I use a strategic elevation to overlook the causes and effects and the future trends of high-tech development, and try to use the Marxist concepts of historical materialism and dialectical materialism to observe and understand S&T in today's world, its connection with the relationships between politics and economics, military affairs and S&T, man and weapons, and so on. The book has a rich content and a great deal of information, is easy to understand and powerfully popularistic, explains the profound in simple terms and is highly readable, and may become good reference material for elementary and middle-level S&T personnel and large numbers of young people and cadres in studying and understanding the high-tech development situation in the world and in China. The publication of this book will play an excellent role in improving the high S&T consciousness of all our nationalities, reinforcing national defense concepts, further forming a social practice of respecting knowledge and respecting skilled personnel, and achieving China's second and third strategic objectives for economic development and welcoming the prosperity and might of the socialist motherland in the 21st Century.

(GAO JISHU ZHANLUE was published by the Military Science Press in September 1991 and is openly circulated by Xinhua Bookstores.)

Experts' Plans for High-Tech Development

92FE0155J Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 2 Nov 91 p 2

[Article by Qiu Kaisheng [6726 0418 3932]: "Experts Suggest Eight Ideas for Developing High Technology"]

[Text] The relevant experts have suggested that we must focus on establishing and perfecting a high-tech R&D management system that conforms to the laws of high-tech development and is adapted to China's national conditions.

The experts feel that the problems that currently exist in China's high-tech R&D activities include everyone doing things in their own way, scattering of forces, redundant research, blind importing, impatience for quick results, and so on. The topical group for "High-Tech R&D Management System Research" in the Chinese Academy of Sciences Science and Technology Policy and Management Science Institute proposed these ideas and opinions:

1. Correctly deal with the relationship between high-tech and traditional technology. Some high-tech can be used to form independent industries, but an even greater portion of high-tech should be used to upgrade traditional industry.

2. Correctly deal with the relationship between planned management and market regulation. For a substantial period of time into the future, there should be an appropriate reduction in directive-type plans for high-tech R&D and an expansion of guidance-type plans and market regulation.

3. Correctly deal with the relationship between development of the whole and the parts (regions or units). We should establish the necessary expert evaluation and expert consulting inspection system.

4. Correctly deal with the relationship between administrative leadership and experts' committees (groups). In experts' committees (groups), there should be an appropriate increase of a specific proportion of management experts, or administrative leaders should participate in decision-making and management.

5. Correctly deal with the relationship among research, development, and production in the high-tech realm. First, we should strengthen integration of work by the State Planning Commission and the State Science and Technology Commission and strengthen integration of the state's economic development plans with S&T development plans and integration of scientific research units with production units.

6. Correctly deal with the relationships among state-run major academies and institutes, institutions of higher education, large and medium-sized enterprises, high and new-tech development zones, S&T enterprises and civilian-run scientific research organs. We should continue to encourage personnel circulation.

7. Correctly deal with the relationship between relying on our own efforts and opening up to the outside world. Scientifically import advanced technology, adopt policies to encourage high-tech studied and developed in China.

8. Correctly deal with the relationship between S&T departments and all areas. We can begin in several coastal cities or economically developed regions in actively improving the social support structure and creating an excellent local environment.

The experts also proposed a "gradual and phased" program for developing high-tech. During the 1990's, we should establish mechanisms that gradually increase the integration of the pull of the market with the push of state plans. When entering the market, we should also be concerned with state investments and management. Government departments should establish special management organs, appraisal systems, risk capital sources, R&D plans, databases, and supervision organs. Differential treatment should be given to R&D organs under different ownership systems according to different value concepts and stipulations. Give consideration to the state regulating and controlling the economy and technology at the macro level and in policies (such as finances and taxation) during the last part of this century and the early part of the next century. Most R&D activities at the basic level should be oriented toward the market. In operational mechanisms, promote the integration of high-tech research, development, production, marketing, and services.

Exploring High-Tech R&D Management System

92FE0114A Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 5, 18 Sep 91 pp 40-42

[Article by Chen Yisheng [7115 4135 0581], Li Guoguang [2621 0948 0342], and Lu Rongan [7120 1369 1344]: "Exploring China's High-Tech R&D Management System"]

[Text] China's high-tech R&D began in the mid-1950's. After more than 30 years of exploration and development, we have made important achievements at international levels in areas like space technology, communications satellite technology, nuclear energy technology, new materials technology, bioengineering technology, and so on, and we have formed an R&D staff of more than 400,000 people who have accumulated relatively rich management experience. This is an important foundation and condition for China's development of high technology and high-tech industry.

China's high-tech R&D management system has undergone two phases of historical development, centered on national defense construction from the 1950's to 1970's, and centered on economic construction beginning in the 1980's. During the first phase, the prominent characteristics of China's high-tech R&D management system were: important breakthroughs, military industry in the vanguard, centralized management, and reliance on our own efforts. Practice has proven that with a background of China's overall national strengths being relatively weak at that time, implementation of this type of system won time and initiative, and turned overall advantages into partial advantages, which thereby ensured that the "two bombs and one satellite" [atomic and hydrogen bombs, artificial satellite] would reach the sky, which increased our national strengths and reduced our lag behind advanced world levels. At the same time, practice has also proven that the system of centralized management and the military industry as the vanguard was the result of the influence of the Soviet Union's model at that time. It was not conducive to the commercialization and industrialization of high-tech achievements, nor was it conducive to promoting technical upgrading in traditional industry and fully fostering the role of S&T personnel. Thus, during the second phase, China conducted active exploration and bold reforms in its high-tech R&D management system and the primary characteristics that are now beginning to reveal themselves are: integration of plan management with market regulation, integration of military and civilian production, opening up to the outside world, multiple levels, compound types, promotion of the commercialization and industrialization of high-tech achievements, upgrading of traditional industry, and so on. Exploration and reform have allowed China to make many important achievements in high-tech development, particularly in the areas of promoting the integration of scientific research with production and the commercialization and industrialization of high-tech achievements, where we have begun to make

certain breakthroughs. Of course, at the same time they have revealed many new difficulties and problems. The biggest difficulty at present is that, based on the China's national conditions and the basic characteristics and development laws of high-tech R&D, we still lack a conscious and full understanding of the patterns and proportions involved in major questions of integration including the integration of plan management with market regulation, military and civilian uses, a multi-level compound pattern, and the development of high tech and upgrading of traditional industry, among others, and even more important is that no comprehensive and systematic experiences have been formed. Thus, many new problems like each doing things their own way, scattering of forces, redundant research, blind importing, impatience for success, and so on have appeared in high-tech R&D activities. These problems have to varying degrees led to several negative outcomes that have affected high tech development and there is a urgent need for more intensive reform in the area of the management system.

To solve these difficulties and problems and discuss a more optimum high-tech R&D management system and its operational mechanisms, we offer the following reform ideas and related policy proposals:

1. Deal correctly with the relationship between high technology and traditional technology

China is a country with extremely uneven development of S&T. Given our national conditions, we should develop high tech at multiple levels. Among them, some high tech can form its own independent industry. An even greater proportion of high tech, however, should be used to upgrade traditional industry. With the exception of a small part that is backward and should be discarded, most of China's traditional technology should be integrated with high tech by developing what is useful and discarding what is not, using it to upgrade traditional industry, and raising it up to a new level. To promote this type of integration, we must solve two problems. One is the question of the proportion of investments in high tech and traditional technology R&D. We feel that to solve this problem we should first strengthen investments in high-tech R&D because opening up more R&D projects is essential for achieving this type of integration. Second, upgrading traditional industry should be the primary objective in the high-tech R&D plans for seven of China's existing fields. The direction of investments should be slanted toward automation, electronic information, and bioengineering technology to enable high-tech R&D achievements in these fields to diffuse into and permeate traditional industry and substantially increase the degree of automation and labor productivity in traditional industries like machinery, metallurgy, chemicals, textiles, agriculture, and so on.

2. Deal correctly with the relationship between plan management and market regulation

Plan management should be implemented for major high-tech R&D projects. This is China's historical experience and a common understanding in several developed nations. Thus, China has implemented directive plans (like the "863"), guidance plans (like the "Torch"), and market regulation (such as development zones) for high-tech R&D and the overall configuration is appropriate and feasible. The current problem is rational coordination of the relationship among the three to integrate them organically. We feel that for some time into the future (10 to 15 years, for example), it would be best to reduce China's directive plans as appropriate for high-tech R&D and expand the portion of guidance plans and market regulation. This is because: 1) Expansion of the latter is adapted to China's national conditions of relative shortages of capital, relatively broad markets, and relatively little risk. 2) Under macro policy regulation and control, development of R&D using the market as a guide is conducive to accelerating the commercialization and industrialization of high-tech achievements and to promoting technical upgrading in traditional industry. 3) Historical experiences and lessons have already proven that R&D on major high-tech projects can undoubtedly promote growth in many disciplines and technologies but the time periods involved are rather long and commercialization and industrialization are both relatively difficult.

3. Deal correctly with the relationship between development of the whole and departments (regions or units)

China is a vast country with a huge population and is unevenly developed, so the phenomenon of the whole and departments, regions, or units each working for their own interests in an uncoordinated way is normal. In the area of developing high-tech R&D, however, if forces are equally utilized by each department, region, and unit, so that limited manpower, finances, and materials are scattered, failure is sure to result. To deal correctly with the relationships among the whole, departments, regions, and units, besides strengthening macro coordination, rationally selecting foci, opening up information among all parties, and carrying out appropriate ideological education, we should also establish the necessary inspection system. In it, the first thing is an experts evaluation system and the second is an experts consulting system. All high-tech R&D projects that have not undergone evaluation and consulting should not be established as projects by the state if they fall under directive plans or guidance plans. If they fall under market regulation, banks should not make S&T loans. Only in this way can we reduce redundant research or blind actions to begin these projects. Of course, the experts conducting the evaluations and consultations should be carefully selected by national and local science and technology commissions and given the authority.

4. Deal correctly with the relationship between administrative leaders and expert committees (groups)

In China's directive plans and guidance plans, the first thing that is determined is the important role of expert committees (groups). This has key significance for increasing the scientific and democratic nature of high-tech R&D management. Practice over the past several years has proven that the expert committee (group) system is truly feasible and should be extended and applied on a national scale, particularly in major projects to attack key S&T problems. Still, we should note that because China's commodity economy is underdeveloped, markets have not maturely developed, and social support structures (especially in the area of reserve strength guarantees) are imperfect, so without effective coordination by administrative leaders the development of high-tech R&D would be rather difficult. During the process of developing the "two bombs and one satellite" in the 1960's and 1970's, we established a technical command line headed by senior engineers and an administrative command line headed by departmental leaders. Each did their utmost to complete their joint development tasks under the unified leadership of the party and fought coordinated battles. This experience still deserves continuation and fostering. Thus, we propose that in the expert committees (groups), there should be an additional proportion as appropriate of management experts or administrative leaders to participate in decision making and management in order to more effectively foster the role of the expert committees (groups).

5. Deal correctly with the relationship among research, development, and production in the high tech field

The relationship among research, development, and production in the high tech field is sometimes referred to as the relationship among scientific research, intermediate testing, and commodity production, or it can be called the relationship between upstream, midstream, and downstream.

At present, the basic situation in China's high tech field is a rather strong upstream, an absent midstream, and a weak downstream. Although quite a few high-tech research achievements appear each year, few are truly converted into commodities. The main reason is a serious detachment of scientific research from production in the system. Although breakthroughs have been made in certain areas through 10 years of reform, basic problems have still not been solved. To be able to truly solve the problem of integrating upstream, midstream, and downstream, we feel that first of all we should reinforce integration of work in the State Planning Commission and State Science and Technology Commission. Second, we should reinforce integration of the state's economic development plans and S&T development plans, and we should reinforce integration of scientific research units and production units. Close integration in the system area is essential for true integration of scientific research, intermediate testing, and commodity production. Thus, we propose that when science and technology commission departments are formulating S&T development plans, planning commission departments should participate. When planning commission departments are formulating plans for attacks on key S&T problems, technical progress, and economic development, science and technology commission departments should participate. This would break down the situation of mutual separation and mutual detachment between these two departments.

6. Deal correctly with the relationship between the main force and fresh troops

In high-tech R&D activities, state-run major academies and institutes, institutions of higher education, and large and medium-sized enterprises are the main force while high and new technology development zones, S&T enterprises, and civilian-run scientific research organs are the fresh troops. Practice has proven that if the main force has a powerful strength and R&D foundation, fully fostering the role of the main force and providing key support to several major academies and institutes, institutions of higher education, and large and medium-sized enterprises are essential for producing high-tech achievements that have scientific levels as well as market prospects. Still, because the management system is inflexible and work tasks are insufficient, the role of the main force at present has not been universally fostered. However, the innovative spirit has been flourishing in high and new technology development zones, S&T enterprises, and civilian-run scientific research organs for the past several years and their forces and role certainly cannot be ignored. Thus, the guidance of S&T policies should provide focused support for the main force and actively support fresh troops, organically integrate the roles of both areas, and foster the advantages of each. At present, we should continue to encourage personnel circulation and support S&T personnel in the main force who do not have sufficient tasks to go into society to establish all types of S&T enterprises and engage in work to convert, apply, and extend high-tech achievements. This is very important for the development of high technology, high-tech industry, and the economy in China.

7. Deal correctly with the relationship between relying on our own efforts and opening up to the outside world

High tech is an international technology and opening up to the outside world is essential for having the conditions to track innovations. At the same time, high tech is also very secret technology and if we do not rely on our own efforts it will be very hard to develop certain key high technologies. The problems we must solve at present are: when importing advanced technology from foreign countries, we must avoid blindness and redundancy by all means; after importing, we must earnestly digest and absorb, carry out redevelopment and innovation, and organize extension and application; we must adopt protective policies for high tech that we can research and develop ourselves within China and use it to open up

international markets; we must further develop international technological cooperation, and in particular should focus on setting up sites and plants in foreign countries and make full use of basic facilities, key equipment, parts and components, market networks, commercial information, and other favorable conditions in foreign countries to develop China's own high tech.

8. Deal correctly with the relationship between S&T departments and other aspects

High-tech R&D touches upon every aspect of all economic and social development. Without an excellent social support structure, high tech cannot develop quickly. At present, China's social support structure is relatively weak and there are substantial discrepancies in concepts and understandings. This is one of the real problems China faces in developing high tech. Still, the international and domestic situations we face at the present time do not permit us to wait passively. Instead, we must work and at the same time create conditions. To deal with this contradiction, we feel that we can use the law of uneven material development to first actively improve the social structure and create an excellent local environment in several coastal cities and economically developed regions. This is both important and feasible. The development and growth of the Beijing Municipality New Technology Industry Development Experiment Zone, for example, is inseparable from improvement in local environment conditions, and in particular is inseparable from support by risk capital from local banks and industrial policies and industry and commerce taxes from the local government. Thus, we should conscientiously summarize and extend these successful experiences to gradually improve and perfect the social support structure for developing high tech in China and continue to create and develop excellent social environment conditions.

Decision on High, New-Tech Industry Reform, Development

92FE0114D Beijing GUANGMING RIBAO in Chinese 7 Oct 91 pp 1-2

[Article: "State Science and Technology Commission and State Reform Commission Decision Concerning Intensive Reform in High and New Technology Industry Development Zones and Promoting the Development of High and New Technology Industry (5 September 1991)"]

[Text] The development of high science and technology and the achievement of industrialization to convert more S&T achievements into real forces of production are of extremely great strategic significance for the readjustment of China's industrial structure, improvement of our overall national strengths, and achievement of our second and third objectives for economic development. To adhere to the strategic decision by the State Council concerning the establishment of State High and New Technology Industry Development Zones and promote the development of high- and new-tech industry, this special decision has been made:

I. Beginning in 1991, Comprehensive Reforms Will Be Resolutely and Gradually Promoted in State High and New Technology Development Zones

The goal of reform is to promote integration of the planned economy with market regulation on the basis of the development requirements of our socialist planned commodity economy to establish operational laws in development zones that conform to our commodity economy, to adapt to the development requirements of high- and new-tech industry and the prevailing international system, mechanisms, and environmental conditions, to liberate S&T forces of production to the greatest possible extent, and to promote economic prosperity. Reform of the enterprise system, management system, labor and personnel system, socialized support and service system, the social guarantee system, and other areas must all be carried out around this objective.

The focus of reform is: in the area of the production materials ownership system, to explore how to resolutely develop all types of economic components jointly with the socialist public ownership system as the main factor; in the allocation system, how to make distribution according to labor the main factor, meaning being able to overcome egalitarianism and prevent bipolarization; in the area of integrating the planned economy with market regulation, exploring ways to integrate the advantages of plans and markets along with concrete complementary policies, measures, and arrangements.

The reforms should make full use of the favorable conditions created by S&T progress in China over the past several years, conscientiously implement all state policies for encouraging the development of development zones, assimilate successful experiences in special economic zones and economic and technological development zones, borrow on several beneficial methods from foreign countries for high-tech parks, strive to build development zones into base areas for the conversion of high and new-tech achievements into commodities and their industrialization, make high and new technology a radiation source that permeates traditional industry, a window open to the outside world, and experiment zones and demonstration zones for intensive reform, optimize the micro-environment, form a large climate, and promote the commercialization, industrialization, and internationalization of China's high- and new-tech achievements.

II. Reform the Enterprise Management System and Administrative Mechanisms, Make High- and New-Tech Enterprises Orient Toward the Market, Make Their Own Administrative Decisions, and Engage in Equal Competition Under Guidance by State Policies and Plans

High- and new-tech enterprises are the primary force and foundation of development zones. These economic entities, which were newly built during reform, contain

favorable conditions for the establishment of new systems and new mechanisms. The central objective in all reform policy measures in development zones is to further create environmental conditions to ensure that enterprises carry out production and management activities in accordance with new operational mechanisms. The production and management activities of enterprises should use the market as a guide and primarily be regulated by the market. The relationships of enterprises to other areas are mainly economic relationships. We must make enterprises adhere to the state's macroeconomic policy guidance and the principles of "raising their own capital, voluntary combination, making their own administrative decisions, taking responsibility for their profits and losses, and achieving self-development and self- restraint", use demand in domestic and foreign markets to make their own decisions on development strategies, open up the scope of administration, and implement the integration of technology-industry-trade and technology- agriculture-trade. With a prerequisite of adherence to the public ownership system as the main factor, create the conditions to enable enterprises with different economic components to engage in equal competition so that the best win and the worst are eliminated. Enterprises should make their own decisions on various forms of internal allocation methods centered on distribution according to labor and implement a labor contract system for all personnel.

With a prerequisite of straightening out property relationships and relationships of duties and rights, enterprises can implement partnership enterprises, cooperative enterprises, limited liability companies, companies limited by shares, and other organizational arrangements. Advocate mutual stock participation and stock control between legal persons, encourage shareholding by means of patents, technical achievements, and other intellectual property, induce enterprise employees to hold stocks in a planned manner, and actively attract foreign capital to buy stocks. Use over the counter trading, allow stock transfers and circulation. Implement a property rights compensated transfer and enterprise bankruptcy system, develop production factor markets, use mergers, contractual responsibility, leasing, auctions, and other arrangements to promote the rational circulation and optimal combination of production factors. Gradually establish new types of responsibility and rights relationships between enterprises and between enterprises and employees.

High- and new-tech enterprises should solidly establish the concept of a commodity economy, reinforce their understanding of competition, improve management and administration, make efforts at all levels to continually increase the technological added value of products, and take the initiative in opening up domestic and international markets.

III. Strengthen Guidance and Control Over the Development of High- and New- Tech Industry, Form Rational Industrial Structures, Promote the Industrialization of High and New Technology

The development of high- and new-tech industry must depend on our existing industrial and agricultural foundation, fully foster the high-tech advantages of the national defense and military industries, use the provision of modernized system designs, technologies, equipment, and other forms to reinforce high- and new-tech's radiation and permeation of traditional industry, promote technical upgrading and structural readjustment in traditional industry, and accelerate the pace of high and new-tech industrialization. Development zones should create excellent systems, mechanisms, and environmental conditions, continually convert the high- and new-tech achievements studied and developed by China itself as well as those imported into commodities, strive to improve quality, raise levels, and increase scales, and make development zones become cradles and base areas for China's high- and new-tech industry and foster their demonstration and promotion roles.

High- and new-tech industry project selection work must be based on China's concrete national conditions and national strengths with preferential selection and focused development of links where we have advantages or where there are blanks or weaknesses internationally. Development zone project arrangements should be linked to economic and S&T development plans, and they should continually increase the R&D capabilities of development zone enterprises, reinforce intermediate testing links, and promote the integration of scientific research, design, production, and administration. We must study and improve the related policies and formulate new measures and methods to encourage scientific research academies and institutes, institutions of higher education, and large and medium-sized enterprises to go into development zones and establish high- and new-tech enterprises or use share participation, joint ventures, and other arrangements to enter development zones, and we should at the same time fully foster the role of civilian-run S&T enterprises. Encourage enterprises in development zones to implement a variety of forms of integrated production and joint ventures with enterprises outside the zone, especially with enterprises in economic and technological development zones and special economic zones, to supplement each other's advantages and work on joint development. All development zones should adapt to local conditions in fully applying local resource and technology advantages, develop unique and advantageous high and new technology, and prevent redundant projects at low levels. On this foundation, make major efforts to develop "fist" products, develop enterprise groups led by high- and new-tech enterprises, form pillar industries and scale administration, and strive to increase the degree of industrialization.

When planning departments and industrial management departments are deciding on capital construction and

technical upgrading projects, they should closely coordinate with the development of high- and new-tech industry, use government orders for preferential purchases of high- and new-tech products, promulgate industry and product technical standards, restrict outdated and backward products and technologies, and use other measures to expand market demand for high- and new-tech products. They should apply financial subsidies, differential profit rates, differential tax rates, loan interest deductions, and other economic levers to encourage and guide traditional industry to apply high and new technology to carry out technical upgrading.

We should use the state's industrial policies and S&T policies as a foundation in comprehensive application of information services and economic measures to strengthen guidance and control over the development of development zones and prevent low-level redundancy and industrial haste. All development zones should base themselves on local resources and technical advantages, integrate with the needs of technical upgrading in traditional industry, formulate good development programs and plans, reinforce guidance and information services, focus on developing pillar industries, form special regional industrial characteristics, and form a rational high- and new-tech industry structure that conforms to China's national conditions. The State Science and Technology Commission will strengthen the content of high- and new-tech projects now being studied, work to provide information on the progress situation, market prospects, and other things, and it will use implementation of the State Science and Technology Commission's development plans and evaluations of development zone development programs to control and guide the directions and investment foci of high and new technology. Local science and technology commissions should coordinate well in establishing, examining, and approving high- and new-tech enterprises and projects.

IV. Expand and Open Up, Promote the Movement of High- and New-Tech Products Into the International Market, Accelerate the Pace of High- and New-Tech Industry Internationalization

Modern high- and new-tech industry is characterized by optimized combinations of the factors of production on an international scale. The higher the technological added value, degree of creativity, and strength of investment of a high- and new-tech industry or link, the greater is the degree of internationalization required. High- and new-tech industry can exist and develop only in competition in the international market and only then can industrialization and internationalization truly be achieved. To achieve the internationalization of China's high- and new-tech industry, we must adhere to the omnidirectional principle of opening up to the outside world by combining S&T cooperation with economic cooperation, combining civilian cooperation with official cooperation, and combining bilateral cooperation with multilateral cooperation, reinforce research on the internationalization characteristics and development trends of modern high- and new-tech industry, and establish correct development strategies. At the same time, we must establish and perfect systems, mechanisms, and environmental conditions in development zones that are adapted to international practices.

With approval by the relevant departments, all development zones should establish technology trade import-export companies and customs branch organs, and set up bonded warehouses, plants, or bonded zones to meet the requirements of modern international technology and economic trade. We should encourage high-and new-tech enterprises to develop in an export-oriented manner, make full use of existing windows open to the outside world in economic and technology development zones and coastal special economic zones, and accelerate the movement of high- and new-tech products into the international market, especially into Third World markets. As needed, give enterprises and enterprise groups having the proper conditions greater administrative decision-making rights over foreign trade, encourage them to go to foreign countries and outside China's borders to establish branch organs and marketing service networks, and simplify import-export activity examination and approval procedures. Provide preferential treatment and protection in areas like tariffs, foreign trade quotas, licenses, and so on for important high- and new-tech industries and high- and new-tech products that are exported to earn foreign exchange and substitute for imports. S&T personnel involved in high- and new-tech product development should be able to participate directly in foreign trade consultation activities. We must earnestly adhere to and implement the state's stipulations concerning simplified examination and approval procedures for some personnel in high- and new-tech enterprises to go abroad several times and truly resolve concrete problems in implementation.

Further optimize the investment environment in development zones, actively attract investors from foreign countries and outside China's borders to make independent investments and joint investments in development zones to establish high- and new-tech enterprises or make risk investments. We must firmly protect the legitimate technical and economic rights and interests of investors from foreign countries and outside of China's borders and assist them in applying for patents in China in accordance with the law, and in fields where Chinese law does not provide protection, we should use the control of the scope of issuing production licenses and other administrative measures to prevent the unauthorized use and transfer of achievements.

V. Widely Attract Qualified Personnel, Create an Excellent Environment in Development Zones for Talented People To Come Forth in Large Numbers and Display Their Talents

The construction and development of development zones requires the struggle of large numbers of superior quality entrepreneurs, specialized technical personnel, and management personnel. We must adhere to the principle of "respecting knowledge and respecting skilled

personnel", encourage the relative concentration of S&T personnel, especially in scientific research academies and institutes, institutions of higher education, and large and medium-sized enterprises with insufficient tasks, to implement the divided circulation of qualified personnel to go to development zones in an organized manner to establish and jointly manage high- and new-tech enterprises and school-run industry, and support development zone construction. Development zones should formulate preferential policies and use recruiting and other arrangements to attract qualified personnel of all categories to come to development zones to work, especially key middle-aged and young S&T personnel, personnel who have gone abroad for study and completed their studies, and Chinese experts in foreign countries who have certain skills.

For specialized technical personnel who have gone to work in development zones, when doing technical job title assessment and recruitment in accordance with relevant state stipulations, we can also implement an internal technical job title assessment and recruitment system within enterprises. For conflicts over technical rights and interests that occur during personnel circulation, on the one hand we should strengthen education concerning respect for the law and professional ethics, and on the other hand we should strengthen coordination and arbitration work. With a prerequisite of retaining development funds and strictly calculating and collecting individual income adjustment taxes in accordance with state stipulations, high- and new-tech enterprises can set the enterprise total wage bill and adhere to the principle of distribution according to labor to pull apart the rankings for individual wage allocation. Promote the commercialization of residences and establish and perfect a social guarantee system to solve problems of circulating personnel in the areas of housing, welfare, unemployment, and so on.

Based on the need for commercialization, industrialization, and internationalization of high- and new-tech achievements, we should strengthen training work and create as quickly as possible a group of entrepreneurs and skilled management personnel who can meet the development needs of high- and new-tech industry and who understand technology, understand foreign languages, know how to manage, and are good at administration. We should highly treasure and cherish high- and new-tech entrepreneurs and the relevant personnel who have made prominent contributions to development zone construction and the development of high- and new-tech industry and provide them with the proper honors and material rewards.

VI. Establish Multiple Channels and Multiple Forms of Finance Capital Systems, Increase Investments in Development Zones, Reform Investment Patterns, Increase Returns to Investments

The commercialization and industrialization of high- and new-tech achievements requires investments and is characterized by high risk. We must gradually increase investments in development zones and establish risk investment mechanisms.

The central authorities and local areas should adopt matching capital and other arrangements to slant toward development zones in areas like planned investments, financial allocations, credit, investment in fixed assets, and so on to support the development of high- and new-tech enterprises.

We should open up finance capital channels and establish and perfect a socialized finance capital system. It should mainly use social capital (stocks, bonds, insurance funds, etc.) and some matching capital allocated by governments in conjunction with actively attracting inputs of foreign investment to establish risk capital funds for high- and new-tech industrialization. We should increase the intensity of investments in key industries, enterprises, and products, and support information consulting, intermediary services, and other support service system construction. We should perfect the capital management system, establish investment management networks, gradually achieve management by objectives and full-process monitoring and control of capital utilization, and increase the benefits of investments and capital utilization. With approval from the relevant departments, high- and new-tech enterprise groups can establish financial companies.

VII. Gradually Establish a Socialized Support and Service System and Social Guarantee System, Create the Conditions for Development of High- and New-Tech Enterprises

To establish enterprise operational mechanisms and avoid enterprises taking the old path of being small but all-inclusive and large but all-inclusive, and enterprise-run society, all development zones must establish and cultivate high-and new-tech enterprises and a socialized service system and guarantee system that serves enterprise development.

Strive to run good high- and new-tech pioneering service centers, provide research and development, trial manufacture and production, and other necessary conditions to support pioneers with high- and new-tech achievements that have definite commercialization prospects and services in industrial and commercial agents, taxation, credit, insurance and other areas to cultivate high- and new-tech enterprises. Establish comprehensive and specialized consulting service organs, provide technical and economic information from China and foreign countries, feasibility discussions, project assessments, and other services, assist enterprises in formulating correct R&D plans and business development strategies. We should formulate the necessary preferential policies to encourage the development of all categories of soft S&T industry. We should develop markets for personnel, technology, capital, materials, real estate, and other factors, establish legal affairs, accounting affairs, contract arbitration, foreign trade agents, and other service organs to provide the intermediary, consulting, and

agent services required for enterprise development. All such organs in development zones should strengthen their professional relationships and gradually form a national high- and new-tech industry information, intermediary, and service system.

Promote reform of the housing system in development zones, gradually achieve socialized management of housing as a commodity. Allow real estate development companies to raise capital for society, use existing financial organs, and actively develop enterprise and individual house purchasing savings and credit services. Gradually establish an old-age and unemployment insurance system based on individual account savings and accumulation and a socially unified medical treatment and health care system. Make a transition in the direction of rational burdens for the state, collectives, and individuals and socialized management.

VIII. In Accordance with the Principle of Simplification, High Efficiency, and Service, Establish and Perfect a New Type of Management System in Development Zones To Promote the Commercialization, Industrialization, and Internationalization of High- and New-Tech Achievements

All development zones should adapt to local conditions in establishing decision-making and management organs, provide them with the necessary authority, represent local governments in carrying out administrative authority, be unified in internal and external affairs, solve major problems in development zone development in an effective and coordinated manner, and provide a complete set of highly efficient service functions to industry and commerce, taxation, finance, banking, international cooperation and exchange, foreign trade, importing and exporting, and other areas to provide comprehensive services to enterprises.

All levels of people's government in the areas where development zones are located should conscientiously implement State Directive No 12 (1991) and, on the basis of actual conditions, formulate development programs and plans for development zones, formulate management regulations and detailed principles for development zones, establish and perfect policy and legislation systems, and focus on guiding the decision-making rights over high- and new-tech industry development. They should do good organization, coordination, and service work, actively cultivate markets, fully foster the role of regulation by market mechanisms, create the environmental conditions for increasing the vitality of high- and new-tech enterprises, and ensure the smooth progress of reform and development in development zones.

IX. Truly Strengthen Leadership Over Comprehensive Reform in Development Zones, Further Liberate Ideology, Be Bold in Practice, Open Up and Advance, Promote Intensive and Extensive Development of Reform

Comprehensive reform in development zones is an integration of intensified reform, reform of the economic system, and reform of the S&T system at deep levels. It concerns the success or failure of high- and new-tech industry development and will inevitably have a broad impact on the cause of China's socialist modernization and construction. People's governments at all levels should closely integrate reform and development, integrate with concrete conditions on the basis of the state's relevant policies, laws, regulations, and the spirit of this decision, actively carry out trial points, experiments, and demonstrations within the limits of their authority, immediately study new situations and new problems that appear during reform, continually summarize experiences, and promote the gradual intensification of reform. All government departments should make major efforts at supporting and coordinating with development zone reform and construction, and make readjustments in the relevant policies and systems using as a standard whether or not they are conducive to the liberation of S&T as forces of production and whether or not they are conducive to the development of high- and new-tech industry. The State Science and Technology Commission will strengthen its management work concerning development zones. The State System Reform Commission and State Science and Technology Commission will meet with the relevant departments, do further research on the relevant sets of policies, guide and assist local areas in studying and formulating comprehensive reform programs for development zones, and select a few development zones for focused promotion. Science and technology commissions and system reform commissions in all areas should work under the leadership of local government, try to cooperate, be bold in exploration and practice, and use intensive reform to promote the development of high- and new-tech industry.

The CPC Central Committee and State Council give the development of high- and new-tech industry a high degree of attention and are full of high hopes. All development zones should fully understand the historical responsibilities they shoulder, foster the Chinese nationality's spirit of self-respect, self- strengthening, and self-support, be bold in exploration, continually progress, and make the proper contributions.

Construction of Inland High-Tech Development Zones Studied

92FE0215D Lanzhou KEXUE JINGJI SHEHUI [SCIENCE ECONOMY SOCIETY] in Chinese Vol 9, No 3, 15 Sep 91 pp 1-5, 17

[Article by Qi Weiji [4359 0251 4921] of the Southwest China Finance and Economics University Social and Economic Information Research Center: "On Construction of High-Tech Development Zones in China's Inland Regions"]

[Text] Developing high technology and high-tech industry has now become a development trend of international society. For the past several years, while formulating high-tech development programs, China has also made construction of high-tech development zones a

strategic measure for developing high-tech and high- and new-tech industry. To date, 38 state-level and provincial and autonomous region-level high-tech industry development zones have been established on the Chinese mainland. In April 1991, comrade Deng Xiaoping wrote an inscription for developing high-tech in China: "develop high technology, achieve industrialization". Jiang Zemin, Li Peng, Nie Rongzhen, and other comrades of the central leadership also stressed that major efforts to develop S&T were the key to achieving China's Eighth 5-Year Plan and 10-year program by striving to develop high-tech industry and build good technology and industry development zones. I want to explore the construction of high-tech industry development zones in inland regions of China.

I. A Renewed Understanding of Construction of High-Tech Development Zones in Inland Regions

High-tech is obtained by scientific research institutes and is a group of technologies at the vanguard of S&T or that have not formally been placed into use. High-tech industry has rather high S&T inputs, produces high-tech products and achieves rather high industrial density and industry with very high economic outputs, and has obvious characteristics like high knowledge, high investments, high risk, high incomes, high permeability, high competitiveness, and so on. High-tech is not equivalent to high-tech industry but as soon as high-tech is placed into use and produces high-tech products, the addition of pull by market demand can achieve the industrialization of high-tech. Everyone knows that technological changes inevitably lead to changes in industrial structures and that the generation and application of high-tech inevitably causes the appearance of emerging industries, destroys the original industrial structure, and causes the gradual achievement of higher levels in the industrial structure.

Some people feel that the development of the Chinese coast and inland regions is very imbalanced and that there are substantial economic and S&T differences. Added to the inconvenient communication, backward communications, capital shortages, and low management levels in inland regions, it will not be easy to achieve success in building high- and new-tech development zones. I find it hard to agree with this.

China's inland regions have abundant resources, enormous basic facilities and an excellent living environment. Labor costs are one-half to three-fourths lower than in coastal areas. There are several universities, research organizations, and key large and medium-sized enterprises with national influence that occupy important positions in R&D in China's aviation technology, new materials, fiber optic communications, biotechnology, nuclear physics applications, and other high-tech fields. Many of their high technologies have been included in the state-level "Torch" plan and attained advanced international levels of the 1980's. Some high-tech products have not only spread throughout China but have also entered international markets and formed a preliminary foundation for high-tech R&D and high-tech industry. Moreover, inland regions have a much broader potential product market and higher added value compared to the coast. As reform and opening up intensify, the direction of foreign investments in China's inland regions has begun shifting toward industrial fields and large projects. All of these things provide a favorable environment for establishing high-tech industry development zones in inland regions.

Moreover, from the perspective of development of the national economy in inland regions, they are backward compared to coastal areas, so if we do not try to fight for high-tech "commanding elevations" in certain fields, it will be difficult to create excellent opportunities and conditions for future social and economic development in inland regions. Moreover, inland regions can only build and develop high and new-tech industry development zones and search for breakthrough points for inland regions in international and domestic economic and technology markets and develop high-tech, new materials, and new products to upgrade technical levels in traditional industry to readjust the industrial structure of inland areas, strive to reduce the economic and technological lags of inland areas behind the developed nations and coastal cities, and raise the status of inland regions in international and domestic competition. Moreover, establishing high and new-tech development zones could also provide "interfaces" for the transfer and permeation of high-tech into traditional industry of inland regions and achieve better integration of S&T and the economy.

Practice has proven that inland regions have made significant achievements in recent years in the high and new-tech industry development zones they have already established. Since May 1988, several provinces and cities in inland regions have used local conditions and needs as a basis for establishing over 20 high- and new-tech industry development zones. These development zones adhere to the principles of "fostering advantages, getting started on projects, moving from the small to the large, and gradually developing". They have made full use of existing foundations and conditions and adopted a variety of development patterns to gradually develop and form multi-disciplinary, multi-category, multi-level, and economically diversified high-tech development groups centered on new materials, new energy resources, microelectronics, bioengineering, precision machinery, electromechanical integration, and so on. They have developed several high and new technologies and their products, many of which have already moved into society. Some have also spread throughout China and opened up international markets, attaining or surpassing advanced international levels of the 1980's, and they have created rather high social and economic benefits.

II. Characteristics of Inland Region High-Tech Development Zones and Problems That Exist

Compared to high-tech development zones in coastal areas, high- and new-tech development zones in inland

areas have these characteristics: 1) The development zones cover large areas. The regional area of high-tech development zones in coastal cities is usually 0.3 to 3 square kilometers, while high- and new-tech development zones in inland regions are generally larger in area than this. The high-tech development zones in Wuhan and Chongqing, for example, both cover areas of more than 40 square kilometers. The vast regions provide large areas of empty ground that can be developed, which facilitates overall plans for development zones and rational deployments of high- and new-tech industry. 2) The development zones have multiple functions. Development zones in inland cities generally combine permeation and upgrading of traditional industry outside the zones with supplementary development to make "full function" comprehensive development zones that integrate technology, industry, and trade and that integrate reform, opening up, development, and experimentation into one body. 3) They basically rely on capital they raise themselves. Although the provinces and cities where the development zones are located may implement several preferential policies and invest substantial capital, the large investments required by development zones are always affected by economic development and tend toward capital shortages. 4) The development zones are closely integrated with urban construction. 5) The development patterns of high-and new-tech development zones in inland areas all rely on existing local industrial and S&T advantages and they are more concerned with developing high- and new-tech industry using the newest achievements of the present day.

Although preliminary achievements have been made in construction of high- and new-tech industry development zones in inland regions, many problems and difficulties also exist.

1. Enterprise problems. In terms of the structure of the ownership system, enterprises under ownership by the whole people still account for more than one-half in development zones while the number of enterprises under the collective ownership system is growing but there is considerable confusion regarding their property rights relationships and there are very few joint venture enterprises and joint investment enterprises. In terms of the scale and structure, enterprises under ownership by the whole people hold an advantage in average fixed assets but capital circulation among enterprises is relatively closed and there is very little mutual shareholding and very few mergers. Within enterprises, however, there is serious division of capital and it is hard to collect capital into high-tech R&D, so it is hard for enterprises to expand in scale and there are impediments to construction of high-tech enterprise joint ventures and high-tech enterprise groups, which has affected the development of high-tech industry. In addition, most high- and new-tech development zone enterprises in inland regions are concentrated in the electronic information industry are there is very little R&D in high-tech industries where they have potential advantages like bioengineering, nuclear physics, new materials, Chinese medicine, and so on. Thus, several enterprises are engaged in normal secondary development and S&T product trade competition, which has continued to pull apart the differences among enterprises in the zones and is unfavorable for the formation of high-tech industry in the development zones.

2. Development problems. During the past 2 years, although all areas and the state have formulated certain preferential policies for high- and new-tech industry development zones, because the state has not provided any form of non-compensated capital to the high-tech development zones, investments for basic facilities like the "seven openings and one leveling" [preparing the infrastructure for a construction project, referring to seven infrastructure components (roads, running water, electricity, telecommunications, gas, drainage pipes, and sewage pipes) and the leveling of ground for construction] and so on that are required to start up high- and new-tech development zones in inland areas depend mainly on local finances. Local finances were limited in the beginning and added to the lack of destruction of the old configuration of departmental ownership systems, impeded investment channels in development zones, and difficulties in implementing capital construction indices, many facilities no longer meet the urgent needs of high-tech enterprise development and the development zones lack other financial measures, so they have no capital to support high-tech. At the same time, departmental ownership of skilled personnel and the wage treatment, job title assessments, welfare guarantees, and so on that are directly linked with it have not been properly dealt with. This has caused the concentration of large numbers of qualified personnel in large academies and institutes and institutions of higher education and makes circulation difficult. All of these things are not conducive to the formation of a social environment that supports high and new-tech development zones.

3. Leadership system problems. The establishment of leadership groups is widespread at present in high- and new-tech development zones in inland areas, as is the establishment of offices and high-tech business startup service centers under them. These leadership groups are composed mainly of primary officials from government and major functional departments. The management authority in this type of leadership management system is relatively centralized, the organizations are integrated into one body, and they strictly enforce orders and prohibitions. This has reduced the problem of arguing over trifles regarding economic activities within development zones and they were rather efficient in the early stages. Because the duties of this system are unclear, the demarcation of authority is unclear, and management is non-standardized in this type of system, however, they do not meet the requirements of development zones for highly efficient, guaranteed, systematized, and standardized management. Development zone offices have limited authority, whereas most enterprises in the zones are

under the jurisdiction of various ministries, commissions, and bureaus. Under restriction and inducement by departmental interests, it is hard to avoid creating friction in overall planning for the development zones and enterprise development.

4. Policy problems. Although the state and local governments have provided many preferential policies for high- and new-tech industry development zones, the policies that have been announced are far from systematic and coordinated. Examples include land management, high-tech market cultivation and competition, and so on. Moreover, many existing policies have not yet been implemented. For example, development enterprise production and management capital construction projects have not received preference for inclusion in local fixed assets investment scales, special bank loans have not been implemented as they should have been, and so on.

III. Development Strategies and Development Models for High- and New-Tech Development Zones in Inland Areas

A. The guiding ideology and development objectives of development strategies

Everyone knows that development of high-tech and high- and new-tech industry involves considerable risks, so formulation of correct development strategies for high- and new-tech development zones is directly related to the growth of high- and new-tech development zones in inland areas themselves as well as to the development of inland regions and even China's national economy. Because of differences in local conditions, there are different arrangements for integrating S&T with production and education, so there should be some differences and unique qualities in the guiding ideologies for construction of high- and new-tech development zones in inland regions. Overall, however, they should adhere to the principle of "fostering advantages, getting started with projects, moving from the small to the large, and gradually developing", focus on high-level new technology development, truly integrate high- and new-tech industry development with technical upgrading in traditional industry outside of development zones and readjustment of the industrial structure, integrate entry into international markets and competition with exports to earn foreign exchange, integrate implementation of the "Torch" plan and using S&T to invigorate provinces (cities) with using S&T to invigorate agriculture, be concerned with fostering the advantages of S&T personnel and the industrial foundation of institutions of higher education, large academies and institutes, key local enterprises, and third-line military industry enterprises within the zones, organize and develop high- and new-tech enterprise colonies and enterprise groups in the development zone, and establish comprehensive development base areas focused on application and development of several categories of high and new technology that integrate reform, opening up, development, experimentation, and diffusion in one body.

The objectives in high- and new-tech development zone development strategies in inland regions should include overall objectives, categorized objectives, and phased objectives. Overall objectives and phased objectives should plan high-tech fields, development directions, and development scales for focused development. Categorized objectives should include industries for focused development, technology development patterns, the scale and structure of high-tech and its products, the organization of ownership systems and scale structure for enterprises in the zones, and so on.

B. Development models and assessments

Given the differences in economic development levels in each of the cities in inland regions and differences in high-tech development zone development strategies and development patterns, there should be different development models for each development zone.

Divided according to management patterns, there are three models for inland high-tech development zones: 1) Making do with whatever is available, starting locally, not dividing into regions, centralized management and decentralized administration (Changsha High-Tech Development Zone, for example). 2) Demarcating regions, centralized management and decentralized administration (Wuhan and Chongqing High-Tech Development Zones, for example). 3) Opening up new regions, unified construction, centralized management and centralized administration, rolling development (Nanjing and Chengdu High-Tech Development Zones, for example).

Divided according to regulation patterns, inland high-tech development zones include the planned regulation type and integrated natural growth and planned regulation type. The former refers mainly to those built via investments by the state and local governments, with plan control implemented for all economic activities in the development zone and the government assuming responsibility for risks. For the latter, besides providing specific startup construction funds for certain high-tech development zones, the state only adopts preferential policies for high-tech development zone construction to make enterprises achieve self-accumulation and self-development. Thus, it has direct effects on the selection of high and new-tech industries and the organization, scale, and structure of the industries in high-tech development zones in inland areas. Moreover, the intensive advantage of the institutions of higher education and scientific research organizations in development zones in new technology R&D may also affect the development of new-tech industry and affect the overall development of development zones. Thus, this type of growth should and must be integrated with regulation by government plans and the state should use industrial policies and taxation, credit, price, land, import-export, and other policies to provide focused support for the group of industries and enterprise groups to make high-tech development zones conform at the macro level with the overall development policies of the state and inland

regions and at the micro level achieve true separation of government and enterprises, invigorate enterprises, and raise their status in domestic international and competition.

Divided according to development and growth patterns, high-tech development zones in inland areas can be divided into: 1) Industry-supported type. These are characterized by relying on the S&T development advantages of institutions of higher education and scientific research organizations inside and near development zones and are supported by large and medium-sized key enterprises. They attract foreign investment and high-tech enterprises from foreign countries for joint development of high-tech. This type of arrangement is conducive to implementation of integrated scientific research, production, and marketing, conserves investments, produces results quickly, and can spur success in construction of high-tech development zones in inland areas. 2) Scientific research and development dominated type. These are characterized by having universities and scientific research organizations as a core and focusing on R&D with some additional development of the corresponding high-tech industry. This helps in fully fostering the role of S&T forces and concentrated development of high-level S&T projects that individuals and collective enterprises in large and medium-sized cities in inland areas are unable to take on, but because inland regions are subject to restrictions including widespread shortages of capital and market demand for high-tech and its products, it is not appropriate to develop them at this time in inland regions.

C. Selection and deployment of industrial structures and dominant industries

Whether or not the structure of high-tech industry is rational not only directly affects the construction of high-tech development zones in inland areas but also affects the economic takeoff of inland regions in the 21st Century. Selection of a rational structure is essential for fostering the functions of high-tech industry and high-tech industry development zones to the maximum possible extent. If there is no unified planning of the industrial structure in development zones from the early stages and instead they wait until after they have developed to a substantial scale and readjustments are made as soon as some irrationality appears in the structure of high-tech industry, it will inevitably require several times the capital and time compared to readjustment of traditional industry. Selection of the industrial structure for high-tech development zones in inland regions must first of all analyze and forecast domestic and international market demand and development trends for different periods to adapt to special needs at different times and for different functions. Second, the selection of high-tech industry projects and dominant industries must be based on the scientific research foundation and industrial technology foundation of development zones, the radiative effects of technological products, the geography of the development zones and inland cities, resource advantages and characteristics, the size of actual and potential market demand, the support environment of inland cities for developing high-tech, and so on. I feel that given the existing conditions of high-tech development zones in inland regions, the structure of high-tech industry should have a dynamic and multilevel ladder-shaped distribution. This means selecting "easy, smooth, and fast" projects and using them as dominant industries to carry out vertical development that integrates scientific research, production, and marketing. For non-dominant industries, those which have the proper conditions can be organized in sequence into zone development. Moreover, the course of future development should serve as a foundation for readjustment and transformation of the positions of dominant industries and non-dominant industries and the corresponding treatment should be provided for industrial policies, industrial deployments, basic facilities, policy measures, and other areas.

The present deployment of industry in high-tech development zones in inland regions lacks regional characteristics and the phenomenon of convergence has appeared in certain industries. Many development zones, for example, have developed the electronics industry. At the same time, because of the situation of multiple programs, departmental separation, and everyone fighting their own battles in the deployment of industry in development zones, the configuration of industry in high-tech development zones lacks stability and continuity. Because development zones have the two basic functions of export-oriented development and radiation outside of the zones, when deploying industries in high-tech industry development zones, not only must the dominant industries be placed in regions that are knowledge-intensive and have a rather high quality ecology and environment as well as convenient communication and communications, but they must also invest in building industries that are capable of upgrading traditional industry outside of the zones and have a powerful capacity for import substitution and export substitution.

IV. Leadership System Problems in High-Tech Development Zones in Inland Regions

The leadership and management systems of high- and new-tech development zones in inland regions must ensure that development zones have highly efficient research, development, production, service, and marketing activities and that they are capable of spurring development zones to establish normal operational mechanisms that are competitive. They should adhere to the principle of high efficiency, flexibility, and simplicity in establishing management organizations for high-tech development zones in inland regions. Prior to the establishment of development zone management organizations, "development zone leadership groups" can be established with primary government officials leading the way and all relevant departments participating. After development zones have entered their growth periods, the principle of "small government, large society" should be the basis for establishing development zone management commissions for unified management of

work within the zones. At the same time, the high-tech business startup service centers established in development zones that serve as high-tech development service entities within the zones should be detached from development zone management commissions. On the basis of development zone development plans, they are involved in basic facilities construction in development zones and provide services like raising capital, managing public areas, communications facilities, technical workshops, intermediate testing workshops, administration and management, legal, information, high-tech management personnel training, product marketing, and so on to high-tech business founding personnel and small enterprises. Until development zones enter the mature stage, the main source of construction capital for development zones should be capital raised by selling their own bonds. When banks and industrial and commercial enterprises make investments, they should be withdrawn from development zone management commissions and development zone high-tech business startup service centers to establish development zone development corporations that use zone development plans as a basis for engaging in development zone basic facilities matching construction, capital raising and utilization, land development, land use rights transfers, building and property management, running high- and new-tech and product trade, and providing comprehensive services including scientific research, production, markets, management, education, and so on to enterprises and institutions in development zones.

V. Establish Perfected Policies and Measures for High-Tech Development Zone Construction in Inland Areas

An excellent policy environment is an important external environment for the development of high-tech development zones in inland regions. A perfected policy system for high- and new-tech development zones in inland regions plays an excellent guiding role for development zone construction. These policies must help in continual perfection of the investment environment in development zones, help in the formation of dominant industries decided upon for development zones, help in the growth of enterprise integration and enterprise groups, help in increasing productive and technical investments in enterprises, increase enterprise competitiveness, help in attracting capital, technology, skilled personnel, and management, help in the integration of scientific research with production and the transfer and diffusion of new technology to upgrade traditional industry, and promote S&T, economic, and educational reform in development zones and the continual raising of grades in industry. The high-tech characteristics of high investments, high risk, short schedules, and rapid changes are followed by continual recombination and optimization of changing temporal and spatial circumstances and national and regional conditions in high-tech development zones. Thus, development zone policies and measures must be comprehensive and have highly efficient order.

1. Investment policies. Choices can be made among increased government investments in basic facilities upgrading and construction, establishing innovation investment funds and risk investment banks, running loan insurance services, establishing various types of civilian financial and investment organizations, issuing high-tech industry stocks and bonds, establishing development zone short-term capital borrowing markets, and so on.

2. Financial and taxation policies. On the one hand, we should truly implement the state high- and new-tech technology industry development zone taxation policy approved by the State Council on 5 March 1991. On the other hand, I suggest that differential taxation policies be implemented in development zones to spur the achievement of the two main functions of development zones of export-oriented development and domestic radiation. There should be reductions or increases as appropriate in income tax rates for technical income as a portion of enterprise income when it exceeds or falls below stipulated standards. High tax rate policies should be implemented for industries that are not suitable for development in development zones so that industrial development moves toward the development strategies selected for development zones or move out of development zones.

3. Labor and personnel policies. Besides adhering to the personnel policies for development zones that are formulated by the state, they should also establish and perfect personnel circulation markets, promote the rational circulation of S&T personnel, and give development zones the authority to transfer, borrow, and appoint all categories of qualified personnel that they require. In management, they can implement socialization of personnel management and achieve macro control of the direction, amount, and speed of qualified personnel flows as a basis, use "bidirectional selection" market regulation as the main factor, and use a guarantee system as a basis for personnel socialization services as a goal model. In implementation, personnel management socialization mechanisms can be brought into civilian-run and collective enterprises. This type of management mechanism has been implemented in the Wuhan Donghu High-Tech Development Zone and solved the problems of people entering enterprises owned by the whole people and difficulties of civilian-run enterprises in recruiting personnel arising from the skilled personnel unit ownership system in the centralized job placement system and the difficulties faced by society for graduates of institutions of higher education and polytechnical schools and difficulties in S&T personnel circulation.

4. Price and foreign trade policies. When the state is formulating high- tech product prices, it should substantially increase the prices of high-tech products and provide high-tech industry with appropriate subsidies. To expand exports of high-tech products from inland areas and foster the role of development zones in export substitution, an agent system centered on development zones making their own trade decisions for high- and

new-tech enterprises and projects can be implemented and the corresponding preferential policies should be provided in tariffs, licenses, foreign exchange allocations, and other areas.

5. Enterprise policies. Establish and develop enterprise colonies formed by various types of ownership systems with a high degree of fusion. We should also encourage horizontal joint ventures between enterprises in development zones and with enterprises outside of development zones to form various types of integrated research, production, and marketing configurations, expand R&D-type administration, and actively promote mergers, shareholder systems, bankruptcy, and other measures to promote continual growth and development of enterprise integration and enterprise groups and increase the domestic and international competitiveness of enterprises in the zones.

6. Legal policies. The state and all local governments in inland regions should formulate laws and regulations suitable to high-tech development and use legislative patterns to fix all mature and effective policies to provide a legal basis for developing high-tech and high-tech industry and economic activities in the zones and to protect and develop normal competition and protect the unification of responsibilities and rights.

Yantai Mayor on High, New-Tech Industry and Yantai Economic Development Goal

92FE0215E Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 11 Nov 91 p 3

[Article by Du Shicheng [2629 0013 2052], mayor of Yantai City: "High- and New-Tech Industry and Yantai's Choices of Economic Development Directions"]

[Text] To adhere to the decision "develop high S&T, achieve industrialization", the Yantai City Government organized the Yantai City Science and Technology Commission, Planning Commission, Economic Commission, System Reform Commission, Economics Research Center, and other units to conduct survey research and debate for 1 month.

I. The Key Is Inducing Leaders at All Levels To Achieve a Third Takeoff in Decision Making and Ideology

Because of the transition from the concept of a planned economy to the concept of a planned commodity economy and on to the concept of an export- oriented economy, there have been two takeoffs jointly experienced in the guiding ideology of economic work by all cadres in Yantai City since reform and opening up. The first takeoff produced rather good "invigoration". The second takeoff mainly resolved problems in the concept of "large markets". The third takeoff in decision making ideology that must be carried out at present is the need to truly shift the decision making ideology of leaders at all levels onto the track on "relying on the first force of production, developing high- and new-tech industry".

For this reason, we must established and strengthen four concepts:

1. Judging the hour and sizing up the situation to accelerate development of high- and new-tech industry are essential choices in economic development. Viewing present development trends, Yantai City is now facing three transitions. They are a shift in overall development directions from expanding "quantity" to improving "quality", a shift from a rate type to a results type in the focus of work, and a shift from a labor-intensive type to a technology and capital-intensive type in the intensive structure of enterprises. The survey showed that to accelerate these three transitions we must shift our support points to the development of high- and new-tech industry and the implementation of "rebirth" in upgrading traditional industry.

2. Creating the conditions to seize "commanding elevations" is a basic guiding ideology for the development of high- and new-tech industry in Yantai City. Successful experiences show that high- and new-tech products are the products of skilled personnel and capital combined with daring and resolution, and these preconditions are also often determined by the boldness and resolution of decision makers.

3. The primary force and uniqueness formed by high- and new-tech industry is the fusion and integration of three large armies: township and town enterprises, state-run large and medium-sized enterprises, and scientific research institutes and institutions of higher education.

4. Working with perseverance and tracking developments should be an important principle for high- and new-tech industry development. The development of high- and new-tech products requires ideological preparation for a "long battle". This is especially true for several products of strategic importance. As soon as we have an accurate understanding, we should go all out. Another characteristic of high- and new-tech products is quick replacement. One development success does not mean ultimate victory. We must track developments, ensure that we are advanced, develop name brands, and cover the market.

One important step in work to improve the decision making ideological understanding and ability of cadres at all levels is short term rotational training in specialized knowledge for primary responsible cadres so that they move from having no understanding of high- and new-tech industry to having a general understanding and from unconscious development to conscious advances, while at the same time preventing the tendency toward blind and rash action. Regarding the sequence of rotational training, we should begin with primary responsible cadres from counties, cities, prefectures, townships, towns, and key state-run large and medium-sized enterprises with better economic and technical foundations and gradually train a leadership cadre staff that can competently develop high- and new-tech industry work. At the same time, to deal with several types of short-term

behavior at present, there should be appropriate readjustments in the direction of examining people's accomplishments in their official careers and assessment of results. The guiding ideology of examinations and assessments should be shifted to overall economic qualities with a focus on greater assessment of technical progress, high- and new-tech industry development, and major project development.

II. Determine Working Ideologies, Implement High- and New-Tech Development Strategies

The basic ideology for high- and new-tech industry development in Yantai City is to create the conditions to cultivate and graft "growth points", concentrate forces, accelerate construction of "S&T parks", support the guidance and formation of "high-tech industry zones", rationally deploy and structure Yantai City's "large scale, high-tech, export-oriented" industry, and make a stronger push to achieve commercialization, industrialization, and internationalization of high- and new-tech products. The idea is for "three-step" implementation.

1. Step 1, the growth point sprouting phase. The focus of work in this phase is to widen the "field of view" in selecting points and strengthen "point" cultivation. 1) Reinforce certification work, formulate and perfect matching policy measures, strive to cultivate and create good conditions for "points" in all areas, and accelerate the pace of their industrialization. 2) Reinforce macro-level industry planning with a focus on forecasting and guidance, make planning for development of high- and new-tech in all industries the order of the day so that it enables developments in the first step to play a "direction pointing" role. 3) In regional deployments, the focus of attention at present should be placed on building S&T parks, straightening out organizations, and strengthening development. 4) Widen our field of view of development, strive to cultivate growth points on a broader scale in more fields, and lay a comprehensive foundation for the development of high- and new-tech industry in Yantai City.

2. Step 2, the industrial framework formation phase. The focus of work in this phase is on strengthening the degree of product interconnections and making breakthroughs in strengthening linkages and extensions of the industrial chain. Select optimum points for focused cultivation of strategic products and establish product frameworks. Focus on developing strategic products, form lines and select points, organize enterprise groups, reinforce coordination and matching up among enterprises, fill in gaps, and form a relatively tight industrial chain. At the macro level, focus on strengthening comprehensive planning, regulation, and control, and concentrate on forming leading industries and industrial characteristics. In regional deployments, strive to form a relatively dense high- and new-tech industry zone along the coastline of northern Yantai City.

3. Step 3, the industrial energy release phase. Work in this phase should focus on making breakthroughs at "points" and radiation and spreading over "areas" to form a "large-scale, high-level, export-oriented" industrial configuration for all of Yantai City. Strive to produce name-brand products in key industries and unique industries, expand market coverage, and expand production scales to form a rather powerful spurring-along capability for the economy of Yantai City as a whole. At the same time, focus on continually strengthening the tracking of developments and fission capabilities of dominant products, maintain advanced levels, and control the "commanding elevations" in industrial development.

From the end of the Eighth 5-Year Plan to the early stages of the Ninth 5- Year Plan, we should strive to complete development of the first two phases and lay a good foundation for economic development in Yantai City to shift toward the phase of dominance by high- and new-tech industrial in the later part of the Ninth 5-Year Plan.

III. Make Breakthroughs With Three Big Problems, Accelerate Progress in Commercialization, Industrialization, and Internationalization of High- and New-Tech

A prominent characteristic of high- and new-tech is high intelligence, high capital, and high S&T. This characteristic determines that the development of high- and new-tech industry requires relatively concentrated qualified high S&T personnel, relatively large capital, and advanced technology as supports.

1. Adhere to qualified personnel leading the way, formulate and implement truly feasible "high S&T personnel plans". Make "high- and new-tech leaders" the core of importing and training. Use various arrangements without regard to the cost to establish a "10,000-man skilled high S&T personnel staff" during the Eighth 5-Year Plan. Arouse a "skilled personnel fever" throughout Yantai City, work at different levels and with foci to reinforce skilled high- and new-tech personnel "direct importing" work. In importing, adhere to the principle of "levels and foci". In addition, make "indirect importing" an important part of our skilled personnel strategy and use a variety of ways to expand channels for importing skilled high- and new-tech personnel.

2. Establish and develop high- and new-tech guidance and training mechanisms, concentrate capital and increase investments in a goal-based and focused manner. Centering on this type of mechanism, the focus at present should be on doing work well in these areas: establishing evaluation organizations, reinforcing certification work, supporting the Science and Technology Commission, recruiting experts, and establishing a "Yantai City 'Torch Plan' Project Evaluation Commission" that integrates full-time and part-time personnel. Readjust the credit structure and increase the proportion of investments in high- and new-tech fields. Use taxation

policies to provide slanted support for high- and new-tech enterprises and rationally combine tax readjustments and reductions based on existing taxation and management authority. Reduce the burden on enterprises, "go into battle with a light pack", make distinctions in investment policies for high- and new-tech enterprises, and spur the start of high- and new-tech projects. Establish development funds at different levels to strengthen scientific research and development capabilities. The Yantai City "Torch Plan" Project Evaluation Commission issues guidance plans for grants from the city-level high- and new-tech development fund and the Tax Bureau and Finance Bureau uses them in rotation in the form of low-interest loans.

3. Speed up the pace of upgrading of existing enterprises, graft high- and new-tech onto traditional industry. Putting together a "large-scale, high- level, and export-oriented" economic structure depends to a substantial degree on technical upgrading of old enterprises. If we wish to accelerate the development of high- and new-tech industry, this also depends to a substantial extent on these old enterprises. For dominant traditional industries, implementation of a round of upgrading objectives should serve as a foundation for a close focus on organizing a second round and third round of upgrading objective plans to give them rather powerful foresight and continuity. "Arrival in one step" should be adopted for key old enterprises to achieve striding-type development and prevent waste arising from excessively short replacement and upgrading cycles and from redundant upgrading. We should fully foster Yantai City's advantages of being at the leading edge of developments, increase its share of technology imports, adopt the necessary administrative measures, and make a decision to resolve circulation problems for the stored property of old enterprises. Promote the circulation of stored property in "setting sun industries" toward "golden industries". Implement planned "clearing out of the baskets and replacement of the chicks" for enterprises that have not developed good products for long periods. Implement planned "suffocation policies" in the areas of plans, capital, taxes, and so on for traditional backward products, technology, and equipment to centralize capital for focused upgrading.

Shanghai's Strategy To Promote High, New-Tech Industries

92FE0215J Shanghai JIEFANG RIBAO in Chinese 21 Oct 91 p 5

[Article by Xu Wenlong [1776 2429 7893]: "With Feet Planted on the Ground and Head Supporting the Sky, Eight Countermeasures For Powerful Promotion of High and New-Tech Industry"]

[Text] The final decade of this century is a decade in which all nations of the world will accelerate development of high- and new-tech industry, increase overall national strengths, and seize strategic commanding elevations for the 21st Century. It is also a decade in which China will catch up with advanced world levels, reduce our lag, and strive to move into the high S&T vanguard in certain fields.

Shanghai began developing high- and new-tech rather early and has a good foundation, but the pace of industrialization has been slow and we have fallen from holding a leading position in microelectronics and other important fields to second or third place in China. We must make a firm decision to catch up with domestic and international "scheduled flights" and fight for first place in high- and new-tech industry regardless of the cost. I will now begin with actual conditions in Shanghai Municipality and suggest eight countermeasures for promoting high- and new-tech industrialization.

I. Establish the Strategic Status of High- and New-Tech in Shanghai's Economic Development

Shanghai is still in the high consumption and low results traditional industry stage, with a per capita value of output of 34,000 yuan, which is about 30 years behind the developed countries. The only way out is to rely on S&T, readjust structures, and take the route of "slipping out of a predicament like a cicada sloughing its skin" [escape by cunning maneuvering]. On the one hand, we should make major efforts to develop low consumption and high benefits high- and new-tech industry, focus on certain pillar industries like modern communications, 1 μm integrated circuits, genetic engineering, computers and software, medium-size bus base areas, civilian trunkline airplane manufacturing, and so on to increase them from the present 2 percent (about 2 billion yuan) of our gross value of industrial and agricultural output to more than 10 percent by the end of this century. On the other hand, we should accelerate the diffusion and permeation of high- and new-tech into traditional industry, make a major effort to develop a results-type economy that conserves energy, materials, and manpower, increase the technological content of products, and raise the contribution rate of S&T progress to economic development from the present figure of about 26 percent to about 50 percent and the per capita value of output to 70,000 to 80,000 yuan. Only in this way can we benefit our participation in the international division of labor and competition from a higher level and eliminate the situation of being restricted by people. For example, in the textiles industry, which accounts for one-fourth of Shanghai's exports, using high- and new-tech for upgrading to attain the level of South Korea could increase our foreign exchange earnings by 50 percent without increases in scale. If we attain the level of Japan, we could triple them. With all of Shanghai similarly exporting 20 billion yuan of goods, we could increase our foreign exchange earnings from the present figure of $5 billion-plus to $10 to $15 billion. Thus, we must certainly establish high- and new-tech in a strategic position in economic development.

II. Choose the Market as a Guide, Have Key Fields and Key Projects Where We Have Relative Advantages

In selecting limited objectives, we should adhere to the principles of market demand first and relative advantages second and prevent "what we have, no one wants, what everyone wants, we don't have". The experts are more inclined toward selecting electronics and information (including modern communications), computer software, biotechnology, and new materials as fields for focused development. For key projects, relevant departments in Shanghai have already proposed more than 20 projects for selection. We could establish five development foci in the area of integrating high- and new-tech with traditional industry: machinery and electromechanical integration, promoting the application and extension of computers in the areas of management systems and production process control, promoting the permeation of biotechnology into agriculture, medicine, and other industries, applying new materials to develop a results-type economy that conserves energy, materials, and manpower, and applying laser technology in industrial processing and medical activities.

The strategic ideology in project selection must be "feet planted on the ground and head supporting the sky". "Head supporting the sky" means focusing on incisive technologies. When we cannot attain commanding elevations in the world, we should also focus on commanding elevations inside China. We cannot run along behind everyone and must strive to take the lead in China. Japan used semiconductors in the 1960's as a tap to promote and economic takeoff. "Feet planted on the ground" means rapidly achieving commercialization and industrialization, pushing into domestic and foreign markets, and forming several "fist products" with suitable marketing avenues that get attention and can cause a stir. We also should establish S&T information systems in related fields, gather the newest trends, provide consulting services, and try to gain mastery after the enemy has struck.

III. Increase the Intensity of Investments in High- and New-Tech Industrialization

High investments are one characteristic of high- and new-tech industrialization. In the late 1980's, Shanghai's capital investments in high-tech research and development accounted for only 0.41 percent of its GNP. Moreover, the investments were scattered and too passive, and there was a lack of risk capital. Calculated at 3 percent of GNP, Shanghai should invest 2.5 to 3 billion yuan each year and attain 14 to 15 billion yuan during the Eighth 5-Year Plan.

Where will the capital come from? One is to implement the relevant provisions in the "Provisional Regulations on Developing of Emerging Technology and Emerging Industry" passed by the Shanghai Municipality People's Congress. By making allocations of 1 percent from the local revenue income retained each year, about 300 million yuan could be gotten during the Eighth 5-Year Plan for use as risk capital. Second, implement the "China Brand" in fighting for large projects from central ministries and commissions to enter the Pudong New Zone. The conditions are "providing land according to projects and providing preferences according to reserve strengths", meaning the exchange of land and transfers for project investments. Third is rational selection of suitable projects for issuing high- and new-tech industry bonds or stock to raise 1 to 2 billion yuan in civilian capital.

IV. Establish Several Intermediary Organizations for High- and New-Tech Industry

The development of high- and new-tech industry depends first on technology imports and second on self-development. Most of our existing high S&T enterprises were established by separation from scientific research organizations by research offices or topic groups. Given their small scale, inadequate investments, and poor capability of defending against risk, it is hard for them to rely on self accumulation to develop and grow. For this reason, Shanghai Municipality and key institutions of higher education should establish several shareholder system investment companies similar to the "Silicon Valleys" in foreign countries to serve as intermediary organizations between scientific research and production enterprises for incubating new high- and new-tech enterprises.

V. Straighten Out the Organizational System for Joint Attacks on Key Problems

Shanghai has more than 1,500 S&T development organizations of various types with nearly 500,000 personnel. Because of barriers between higher and lower levels and between departments and regions, barriers between industries, everyone doing things their own way, and the formation of separate systems, it is very hard to grasp the momentum and form powerful joint forces. This situation cannot be allowed to continue. One solution is to advocate the "Chinese Brand" model in which the state, local areas, and enterprises jointly invest in establishing scientific research and development companies or development-type intermediate testing base areas, "build nests and entice chickens", and incubate high- and new-tech enterprises. A second one is to induce scientific research units or some science offices to enter enterprise groups or large enterprises and focus on implementing integrated management of "scientific research—intermediate testing—batch production—marketing" for projects. A third is to use the S&T achievements of scientific research units or institutions of higher education to establish joint investment and cooperative enterprises with high- and new-tech plants and businesses in foreign countries and take the route of internationalized cooperation. A fourth solution is to separate out some state-run small enterprises and place them under the jurisdiction of some scientific research organizations or institutions of higher education for participation in S&T project intermediate testing, batch production, and marketing.

VI. Gradually Perfect Sales Networks and Marketing Staffs

Few people are involved at present in high- and new-tech product marketing and after-sales services and they have low educational levels and poor professional qualifications. High- and new-tech industry should adopt completely new operational mechanisms, make major efforts at stronger opening up of international markets, and reinforce sales networks and marketing staffs. First, purchase or merge with high- and new-tech enterprise property rights in foreign countries and buy production technology and marketing networks to enable technical upgrading in our own enterprises and use marketing networks to continually move products into international markets. Second, mobilize some S&T personnel who have a pioneering and innovative spirit to participate directly in management. Having S&T personnel become involved in management helps in obtaining market information and developing high- and new-tech products with sales avenues based on market demand. Third, conduct training in the product technology area for existing sales personnel.

VII. Attract More Top-Notch Personnel To Engage in Industrialization Work

Attracting and broadly collecting skilled S&T personnel to form S&T development advantages in a particular field is one key to success in high- and new-tech industrialization. Shanghai has not reinforced its qualified personnel advantages for the past several years. Instead, they have flowed away. This has profound effects on "industrialization" and should receive attention.

Consolidating staffs and attracting more skilled personnel to become involved in "industrialization" first of all requires bold efforts to utilize top-notch middle-aged and young skilled S&T personnel under 40 years of age and push them toward posts as discipline leaders or project responsible persons. Second, we must create an excellent working environment for S&T personnel involved in "industrialization" and give them preferential treatment in wages, job titles, housing, and other areas. Given the risky nature of high- and new-tech development, a policy of "coming and going freely" should be implemented for the relevant S&T personnel to allow them to return to their scientific research organizations in the event of failure. S&T personnel who come from outside areas to Pudong New Zone to participate in attacks on key problems should be provided with preferential treatment in the areas of reporting for residence permits, listing of job titles, and living arrangements.

VIII. Implement Preferential Policies for High- and New-Tech Industry, Strengthen Legislative Work

There are now quite a few preferential policies for high- and new-tech industry but they have poor manipulability and are not implemented. One method is to integrate with the characteristics of each project, clearly formulate the corresponding investment, taxation, personnel, awards, and other "project policies" on the basis of preferential policies of the state and local areas related to "industrialization" to serve as matching measures for inclusion in feasibility reports or contractual agreements. A second method is to establish special policy management personnel in the Shanghai Municipality High- and New-Tech Industry Office to conduct survey research of the policy implementation situation for each project and guarantee that all preferential policies are implemented.

Legislation leads the way and is extremely important in the development of high- and new-tech industry. The concrete content of legislation at present can include: restrictions on imports that can be manufactured in China and in which quality is up to standard, stipulation of import channels and collection of high restrictive import taxes on similar products from foreign countries, encouraging enterprises and institutions to utilize Chinese-made high- and new-tech products, and so on.

Shanghai Aims To Develop High, New Technologies At Any Cost

92FE0276G Shanghai JIEFANG RIBAO in Chinese 19 Dec 91 p 1

[Article by Dong Qiang [5516 1730]: "Shanghai Municipal Government Formulates Several Policy Measures To Develop High and New Technology Industry Without Regard to the Cost, Focusing on Developing Electronic Information, Aerospace, Marine Oil and Gas, and Biotechnology"]

[Text] The Shanghai Municipal Government proposed a series of policy measures for developing high- and new-tech industry at the Shanghai Municipality People's Congress Standing Committee Meeting on 18 December 1991 that called for fighting for "first place" for Shanghai in high- and new-tech industry development regardless of the cost to maintain Shanghai's vanguard position in the national economy and win the right to make its own decisions regarding participation in the international division of labor and competition. The preliminary policy measures formulated by the Shanghai Municipal Government include:

1. Formulating "Shanghai S&T Progress Regulations" to straighten out relationships among all areas and to standardize and fix the rights and duties of S&T organizations, enterprises, and S&T personnel in promoting S&T progress in Shanghai Municipality as well as various preferential policies and so on in the form of local laws and regulations. A very important aspect of this is making clear legal stipulations regarding the development of high- and new-tech industry. At the same time, we should also focus on revising the "Shanghai Provisional Regulations on Developing Emerging Technology and Emerging Industry" and make substantial readjustments in leadership organizations for high- and new-tech industrialization.

2. After examination and approval, high- and new-tech enterprises can organize limited liability companies to collect shares and raise capital from social investments. Enterprise management mechanisms can utilize a manager responsibility system under the leadership of a board of directors in joint investment enterprises to make their own management decisions, take responsibility for their profits and losses, and conduct trials of certain methods in the labor and allocation systems based on "three capital source" [foreign capital, overseas Chinese capital, and Hong Kong and Macao capital] enterprises. The inventions, innovations, and patents of units and individuals (off-the-job inventions) can be used for investment in the form of technology shares.

3. Increase investments, centralize their utilization, improve the returns to investments in high- and new-tech industry. For example, increase the strength of investments and establish risk funds based on its high investment, high risk, and high benefits characteristics. Issue some medium and long-term construction bonds or shares as appropriate to raise capital from society. High- and new-tech enterprises included in development plans for the Eighth 5-Year Plan can set aside a higher proportion of technology development funds from their sales volumes during a particular year than in other industries. A specific amount of the total investments in capital construction in Shanghai each year will be arranged for use mainly in supporting construction of key laboratories, intermediate testing base areas, and engineering experiment (testing) centers and for replacing large instruments and equipment in scientific research units.

4. Support and encourage all ministries and commissions of the central government and all provinces, municipalities, and autonomous regions to come to Shanghai and invest in high- and new-tech projects and enterprises. They can make independent investments as well as cooperative and pooled capital investments. Implement a policy of "providing land according to projects, giving preferences according to investments". For certain major high- and new- tech industrialization projects, make special arrangements for special matters and special approval for special matters, implement certain special policies for greater preferences.

5. Implement preferential taxation, depreciation, and export policies, support the growth of high- and new-tech enterprises. For example, give high- and new-tech enterprises which have developed rather good export services the right to make decisions regarding management of foreign trade in accordance with relevant state stipulations. The main commercial and technical personnel in high- and new-tech enterprises can be given procedures for leaving and re- entering China several times that are effective for 1 year. Give preferences for raw materials and product import channels, foreign exchange management, retention, customs management, and other areas.

6. Encourage the establishment of high- and new-tech enterprises, create an excellent development environment. For example, explore new mechanisms for high- and new-tech industrialization in the Caohejing Development Zone, implement new policies in personnel recruitment and mobility, wage treatment, medical insurance system, and other areas, and so on.

7. Reinforce training, improve treatment, attract superior quality personnel from within China and from foreign countries. Preferential consideration should be given to S&T personnel in the areas of wages, treatment, job titles, and so on for S&T personnel who establish enterprises or go to work in high- and new-tech enterprises. Flexible policies for "free coming and going" can be implemented for S&T personnel who go to work in high- and new-tech enterprises. Enable high- and new-tech research and production units that absorb superior quality personnel from China and foreign countries who come to Shanghai to work to make arrangements in the areas of residency permits, registrations, job titles, residences, and so on. In particular, several departments in China that currently have weak technical forces can be given preferential consideration for transfers of all people in foreign countries who return to China, who have made important S&T achievements in China, and who are discipline and specialization leaders, and arrangements can be made for their families.

The principles, key objectives, and policy measures for high- and new-tech development in Shanghai during the Eighth 5-Year Plan have already been drafted. Shanghai Municipality vice mayor Liu Zhenyuan [0491 2182 0337] received a special report commissioned by the Shanghai Municipal Government at the 30th Meeting of the Shanghai Municipality Ninth People's Congress Standing Committee that continued on 18 December 1991.

Work in Shanghai to develop high- and new-tech and its industry began in the early 1970's and preliminary achievements have been made during the past 20 years, especially since reform and opening up. The Shanghai Municipality People's Congress has formulated, promulgated, and implemented the "Shanghai Municipality Provisional Regulations for Developing Emerging Technology and Emerging Industry" and "Shanghai Municipality Provisional Regulations for the Caohejing Emerging Technology Development Zone" that created favorable conditions for the startup and development of high- and new-tech industry in Shanghai Municipality. Shanghai now has 147 high- and new-tech R&D units with more than 10,000 personnel that achieved a value of output exceeding 2 billion yuan in 1990. However, Shanghai's high- and new-tech and its industry cannot meet the requirements for readjusting the industrial structure and upgrading traditional industry. Many difficulties and latent problems exist that are manifested primarily in too few investments, overly long battlelines, inflexible systems, and less than vigorous policies.

The principle for future development of high- and new-tech industry in Shanghai Municipality proposed by vice mayor Liu Zhenyuan on 18 December 1991 was to concentrate forces, have prominent foci, orient toward the market, and improve results to form benevolent cycles and mechanisms for high- and new-tech industrialization as quickly as possible.

Liu Zhenyuan revealed that Shanghai Municipality will focus on developing the four main high- and new-tech industries of electronic information, aerospace, marine oil and gas development, and modern biotechnology. The focus is on development of high- and new-tech enterprise technology and equipment to attain international levels of the mid and late 1980's. On the basis of perfecting and developing the Caohejing Emerging Technology Development Zone in Puxi [area west of the Huang Pu], accelerate construction of the Zhangjiang High S&T Park in Pudong [area east of the Huang Pu] and focus on developing the modern electronic information industry and modern biotechnology. During the Eighth 5-Year Plan, 1.5 square kilometers of this high S&T park will be developed in the first phase and they plan to import 80 production and scientific research units from China and foreign countries with 15,000 employees for a gross value of output of as much as 1.5 billion yuan in high- and new-tech industry.

The Shanghai Municipality People's Congress Standing Committee Plenum held on 18 December was chaired by deputy director Wang Chongji [3769 1504 1015]. The meeting considered the Shanghai Municipality Acceptance and Dispatching Management Regulations (Revised Draft), Decisions Concerning Revision of Shanghai Municipality's Tree Planting and Afforestation Management Regulations (Draft), and the Shanghai Municipal Government's Report on the Situation in Developing High- and New-Tech and Its Industrialization. The meeting also listened a report from the Shanghai Municipality People's Congress Education, Science, Culture, and Health Commission concerning several proposals regarding high- and new-tech and its industrialization in Shanghai Municipality.

Shanghai Speeds Up High, New-Tech Industry Development

92FE0114G Shanghai JIEFANG RIBAO in Chinese 19 Oct 91 p 1

[Article: "Shanghai Accelerates Development of High- and New-Tech Industry, Focuses on Electronic Information, Aerospace, Marine Oil and Gas, and Biotechnology"]

[Text] During the later part of the Eighth 5-Year Plan, high- and new-tech industry in Shanghai Municipality will account for 5 percent of the gross value of industrial output in the entire municipality and the yearly value of output will be about 10.9 billion yuan. On the basis of consolidating and perfecting Caohejing Emerging Technology Development Zone, 1.5 to 2 square kilometers of the Pudong Zhangjiang New Technology Park will be opened during the Eighth 5-Year Plan. It will absorb 80 high-tech enterprises from China and foreign countries and attract 15,000 S&T personnel, and will reach a yearly output value of 1.5 billion yuan. This was revealed in a scholarly report "Accelerating Development of Shanghai's High and New Technology Industry" by Shanghai Municipality Planning Commission chairman Xu Kuangdi [1776 0562 6611] on Shanghai Science and Technology Day.

Xu Kuangdi said that Shanghai's seven high and new-tech industries, which include the electronic information, aerospace, biotechnology, new materials, and other industries, had a value of output of 2 billion yuan during 1990, equal to 2 percent of the gross value of industrial output in Shanghai Municipality. The lag behind the advanced nations of the world in levels in these fields is about 15 years. To reduce this lag, after several rounds of sifting through, a decision has now been made to focus on the four areas of electronic information, aerospace, marine oil and gas, and biotechnology along with the new materials associated with them.

In the electronic information industry, yearly output by the end of the Eighth 5-Year Plan should reach about 2 million lines of program-controlled exchange equipment, 50,000 digital portable telephones, 150,000 kilometers of optical fiber, and 8 to 10 kilometers of optical cable, and this will promote the production of several types of electronic components. For computers, the focus is on developing 32-bit minicomputer workstations to attain specific scale benefits. They will also accelerate development of portable and laptop computers, and the value of output of computer hardware and software should reach about one-fifth of the gross value of output of high and new technology. The state will establish a Microcomputer Engineering and Research Center in Caohejing. It will complete a State Microelectronics Materials and Components Analysis Center and Application-Specific Integrated Circuit System State-Level Laboratory at Fudan University. It will complete the Enclosure Production Line expansion project at Shangwu Plant 19. It will establish an Ultra-pure Agent Production Base Area with a yearly production capacity of 4,000 tons and more than 20 product varieties.

In the aerospace industry, the focus will be on trunkline aircraft, aviation components, carrier rockets, applications satellites, and air defense missiles.

The initial phase of development of East China Sea oil and gas fields will attain a scale of several 100 cubic meters of natural gas and the corresponding condensed oil and crude oil for use as an industrial and civilian energy resource. Natural gas will be shipped to Shanghai by pipeline from Waigaoqiao.

In the area of biotechnology, a kilogram-grade interferon production capacity will be formed. The existing cephalosporin production capacity will be doubled to reach a

yearly output value of 500 million yuan. Veterinary biopreparations will also be developed. In conjunction with these four points of focus, major efforts will be made to develop new materials for microelectronics, communications, aerospace, components and instruments, and the automobile industry to develop from the strength types of the past to functional types. The focus will be on completing a 1,000 ton-grade high- strength engineering plastic and plastic alloys and 30,000 square meter fluorine ion exchange film production base area. In addition, non-crystalline and other types of new materials will be moved from the laboratory into industrial production.

Xu Kuangdi also said that a set of preferential policies will also be provided to guarantee the achievement of this objective.

Hastening Development of Computer Industry

92FE0401B Wuchang KEJI JINBU YU DUICE in Chinese Vol 9 No 1, Jan 92 pp 44-45

[Article by Yang Jun [2799 7486] and Lin Fan [2651 1581], Management Institute, Wuhan Engineering Academy: "Exploration of Problems in Accelerating Development of China's Computer Industry"]

[Text] The computer industry, which serves as an important indicator in judging a country's economic strength and technological progress, has developed by leaps and bounds in China during the past decade to become a bulwark for the transformation of traditional industries and for vigorous development of the national economy. However, the computer industry is a complex knowledge-intensive, technology-intensive, and capital-intensive industry requiring scientific research and development. Furthermore, China's economic development has relied for a fairly long time mostly on expanding the size of traditional industries. No external environment in the form of markets, commodity circulation, and scientific research beneficial for development of the computer industry has been formed. In addition, the intensity of economic investment and scientific research investment in China's computer industry has been below the threshold for high technology industries, and industrially developed western nations have instituted a ban on shipments of high technology and restrictive policies against China. In addition, because of the rapid development of computer technology, the ever increasing speed with which products are replaced and updated, as well as China's poor quick reaction capability and ability to adapt, loss of macrocontrol, and short-term behavior within the industry, China's computer industry lags far behind the rest of the world in terms of product performance, quality, and variety of products, as well as in terms of the level of production, domestic ability to provide key components, and the extent and range of product application. Furthermore, the gap is widening even further. Consequently, China's computer industry is neither able to compete with foreign products, nor is it able to meet needs in development of the national economy. The situation is fairly grim.

Of priority importance in changing this situation to permit fairly rapid development of China's computer industry is the timely formulation of genuinely feasible strategic goals and thetaking of vigorous actions consistent with China's circumstances and based on the overall trend of world computer development, fullest use made of the superiority of the socialist planned economy to open up international markets to garner maximum economic returns. For the near term, emphasis must be placed on work in the following regards:

1. Orientation Toward Both the Domestic and Foreign Market in the Development of a Truly Foreign-Oriented Economy

Incomplete statistics show China's computer industry has a production capacity of 16.7 billion yuan of output value per year, but the capacity of China's computer market for the past several years has hovered around approximately 4 billion to 5 billion yuan, or only 40 percent of production capacity. This situation seriously impairs healthy development of the country's computer industry. In addition, by limiting goals only to the domestic market, not only is it impossible for computers to realize the economies of scale, but it is also impossible to change the present situation substantially. Therefore, finding ways for China's computers to enter the international market, building an externally oriented industry and markets, is a problem that must be solved for rapid development of China's computer industry. Of most importance in the development of an externally oriented economy is industry-wide inculcation of the concept of an externally oriented economy to bring about an optimized gathering together of production elements on an international scale. Second is to wage a war against bastions, concentrating scientific research, production, and instruction to carry out a technological attack on key problems in order to produce products that can compete in the international market in terms of technological standards, performance and price. Third is to expend major effort on the building of a number of entrepreneurial blocs that can compete internationally in creating brand names that establish a reputation. Fourth is the need to train a number of outstanding people who understand technology, understand management, and understand the complexities of foreign trade. Fifth is to improve business enterprises' quick response capabilities so that they can quickly change their products as products develop and change.

2. Adoption of All Administrative and Legal Means To Advance Normal Development of the Computer Market

One of the main reasons why China's computer industry did not develop entirely as hoped in recent years was the loss of macrocontrol and microregulation of the computer market. This resulted in "development everywhere," "starting up projects without due thought," "duplicatory imports," "scattering of funds," and "everyone doing things in his own individual way" in the development of computers in China. This situation produced rampant speculation and profiteering, smuggling, and buying solely for the purpose of reselling at a profit. Foreign products flooded the country, seriously injuring China's computer market. Surveys show a market share of approximately 46 percent for Chinese manufactured computers in recent years; the rest of the market is occupied by foreign products. Therefore, not only must the industrial sector itself pay attention to improving product quality, increasing variety, lowering costs, and increasing the international competitiveness of its products, but the state must adopt all effective compulsory administrative and legal methods in diligent

improvement of the management of China's computer market. Right now the large scale importation of complete machines, or the disguised importation of complete machines as disassembled complete machines must be strictly controlled when similar machines can be provided out of domestic production. For products that still must be imported, a system of strictly accountable unified control must be instituted, rigorous examination and approval exercised to prevent importation through different channels as a means of protecting China's own computer market.

3. Better Research on Applied Computer Technology, Establishing a Vocationally Complete Applied Computer Research System

The Academy of Sciences, institutions of higher education, research institutes, and the industrial sector must make a rational division of labor, closely cooperate with each other, and reduce unnecessary duplicatory research. They must work in conjunction with national pilot projects, emphasize engineering projects, the "863" scientific research plan, and the establishment of key laboratories. They must regularly make critical technological breakthroughs, improve research in mainstream and peripheral disciplines such as systems analysis, systems synthesis, systems isomorphism, mathematical models and applied software, artificial intelligence, computer networking technology, computer communications technology, and computer technology economic results analysis and evaluation methods. In addition, for research on key projects, forces must be concentrated to wage a war against "bastions," a "national corps" formed for the study of applied computer technology. We cannot take the old road of wandering here and there in a relaxed approach to research.

4. Priority to Scientific Research, Linking Research to Production To Accelerate the Commercialization of Research Results

Scientific research and industry are an upward rising, spiral-shaped revolving system in which scientific research plays the leading role. Without research, there can be no industry to talk about. In the link-up between scientific research and industry in China, the commercialization of research results happens to be a weak link. For example, during the Seventh 5-Year Plan China produced more than 28,000 computer-applicable achievements, but the number translated into production and put to practical use, and the number from which economic returns were made were minuscule. It must be noted that the translation of research results into commodities is a continuing process that is more difficult and a more complex than the research itself. The process of converting research results into products and marketing them requires an expenditure of between five and ten times more manpower, materials, and financial resources than the research. Therefore, while giving priority to research and emphasizing product development, serious attention must also be given to the study of production techniques and technologies. From the very time that a product is approved for production, problems in future production and with the economies of scale must be considered. Only in this way can research and production be paired in a benign cycle.

5. Change From "Emphasizing Hardware While Slighting Software" For Vigorous Development of the Software Industry

Plans for the "commercialization of software," "software exports" and "using software as a means of promoting hardware" are frequently discussed in China, but so far there is still only much thunder but little rain. The software industry's tendency to "emphasize hardware while slighting software" has not fundamentally changed. Unless effective action is soon taken, the gap between China and developed countries in the software industry will widen further. Therefore, first, a policy tilt to nurture the software industry and provide needed investment must be made, efforts going to the production of a series of products and hot-selling products. Efforts should be made during the Eighth 5-Year Plan to build several externally oriented software industry bases. Second is research on the formulation of software design standards and specifications, standard technological processes for software products, cost accounting, and registration of software products to promote the building of an environment for software development and channels for its distribution. Third is the adoption of flexible and elastic policies for effective and gradual entry into international software markets. Examples include joint venture and partnership software enterprises with foreign firms; the launching of contractual development businesses with foreign firms commissioning software; and giving close attention to studying and understanding international software business practice, methods, etc.

6. Give Proper Position to the Development of Large and Medium Size Computers Accelerating Production of a Whole Series of Computers at Many Levels

Large and medium size computers are an important technology that is indispensable to national economic development, social progress, and national defense and security, but foreign countries severely limit China's importation of large and medium size machines. China can only accept the numerous irrational conditions of sellers in order to buy or lease low level computers in general use. China's importation of high speed, high precision computers is more rigorously embargoed, their delivery strictly prohibited. In addition, unless China develops its own large and medium size computers, it will have to spend large amounts of foreign exchange endlessly. It will never be able to get away from tagging along behind others in a passive and vulnerable situation. Therefore, for some time to come, while vigorously developing microcomputers and small model computers, we must use our own technical talent and existing equipment to do more research on large and medium size machines, ultimately founding our own large and medium size computer industry bases. This is a matter about which those concerned should pay attention.

7. Research To Improve Business Enterprise Management and Information Systems For Widening Computer Applications

In the final analysis, it is business enterprises that have to develop a computer industry. Improving the degree to which they are applied to the country's business management and information systems will play an important role in accelerating the development of computers. Right now, the first thing to be done is to intensify full reform of the economic system and enterprise management, increasing and improving understanding about making business management more modern, more scientific, standardized, and systematized. Second is to make clear the functions and purview of computer management. The state must draw up detailed implementation measures and standards for acceptance to widen the range of computer use. Third is the building of a body of feasibility studies, designs, and implementation procedures and standards, simultaneously continuing to amplify and perfect the system for initiating projects, initial examination, mid-term inspections, examination preliminary to acceptance, and assessment. Fourth is vigorous efforts to improve the professional skills of software personnel, building a system having the best mix of abilities and knowledge.

8. Research on the Development of Smart Machines To Keep Up With Advanced World Levels

All of the major industrially developed nations in the world today recognize the enormous potential of artificial intelligence They are drawing up plans and investing huge amounts of money from the strategic heights for the development of smart machine systems and associated technologies. Faced with this challenge, China must fully realize the difficulty of artificial intelligence and smart computer research, devote a high degree of attention to basic research and key technological breakthroughs, and keep up with world mainstream computer technology. Second, it must emphasize development of computer application systems and research on intelligence interface technology, using application needs to guide the development of smart computers. The main thrust in work on smart machines right now is on building and perfecting work stations, major efforts being devoted to the smart machine software environment and to intelligence interfacing that makes dialogue between men and machines more convenient. Efforts are being made to catch up with other developed countries in smart machine research during the Eighth 5-Year Plan.

Computer Industry's Eighth 5-Year Plan Plans

92FE0417E Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 5, 29 Jan 92 p 1

[Article by Han Yun [7281 0061] and Liu Rulin [0491 3067 2651]: "Chinese Computer Industries' Eighth 5-Year Plan Plans Set. To Concentrate on the Building of Three Large Software Bases and Three Large Microcomputer Production Bases During Eighth 5-Year Plan"]

[Text] The reporters learned from those concerned that the Chinese computer industry's plans for the Eighth 5-Year Plan have been preliminarily set. During the Eighth 5-Year Plan, the Ministry of Machine Building and Electronics will concentrate a substantial amount of investment to support the technological transformation of three software production enterprises, and three microcomputer production enterprises, making them the country's microcomputer and software development and production bases.

The three microcomputer production bases are the Chinese Great Wall Computer Group (Shenzhen) Company, the Chang Jiang Computer Group Company, and the Tide Group Company. The state will invest nearly 300 million yuan in these three enterprises during the Eighth 5-Year Plan. Following technological transformation, these three enterprises' aggregate microcomputer production capacity will exceed 350,000 units.

The three software bases are the China Computer Software and Technical Services Corporation, the Shenzhen Software Development Company, and the Shanghai Pudong Software Development Company. State investment in these three enterprises during the Eighth 5-Year Plan will exceed 200 million yuan. Following technological transformation, the China Computer Software and Technical Services Corporation will build the Chinese software industries' northern base, which will produce basic software for the most part, but which also produce application software and have a systems integration capability. Shenzhen and Shanghai will seek to attract enterprises by building two modern software export parks. Once completed, the output value of software from the three software bases will exceed 1 billion yuan.

Beijing Strengthening S&T Information Work

92FE0215I Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese 19 Oct 91 p 1

[Article by reporter Shi Wenjie [0670 2429 1240]: "Beijing Making Major Efforts To Strengthen S&T Information Work—Laying a Good Foundation for Correct Policies"]

[Text] The development of S&T and the economy cannot be separated from S&T information work. Without assistance by S&T information, we will find it difficult to be assured of success in constantly changing S&T competition. Beijing Municipality recently decided to adopt a series of effective measures in a major effort to strengthen S&T information work.

S&T information is an important social wealth and resource, an important foundation for S&T, economic, and social development, and a guarantee for correct decisions and development of S&T activities. The leadership of Beijing Municipality has called on all units to combine raising of their consciousness with true strengthening of leadership over S&T information work, to make S&T information staffs a part of the overall

decision making system, and to create the conditions for opening up a new situation in S&T information work.

Beijing Municipality as a whole will implement two-level management at the municipal and bureau (corporation, prefecture, and county) levels over the S&T information organizational system and specialized S&T information networks. Science and technology commissions in all bureaus, corporations, prefectures, and counties should have a deputy bureau director, assistant general manager, and deputy director to manage information work and assign a leader in S&T departments to have concrete responsibility for managing information work.

The Beijing Municipality Science and Technology Commission has decided to increase its allocations of specific duties and topic funds to its Information Office. All related departments will also expand funding sources for information organizations under their jurisdiction and make appropriate increases in funding inputs. Among them, large equipment items are to be included among special allocations in department development plans, with the special funds being used for special purposes. Expenditures for advanced surveys of information prior to the establishment of S&T projects will be included in project expenditures. For information research topics in bureaus and corporations, about 10 percent of industrial and commercial funds from block expenditures will be used to support soft science research. Other departments will make adjustments in scientific research expenditures to deal with this question.

Stabilizing information staffs and improving the quality of information personnel are key factors in raising S&T information work service levels. The Beijing Municipal Government has called on leaders at all levels to make S&T information personnel feel that information work is extremely important and well worth doing and to show concern for them in ideology, in work, and in livelihood treatment. At the same time, there should be basic quality requirements for the posts of S&T information personnel and various arrangements should be adopted to strengthen specialized training and continually improve the professional quality of S&T information personnel.

Nation To Implement 'Multiplication Plan'

40101015A Beijing RENMIN RIBAO in Chinese 7 Mar 92 p 1

[Article by Liu Guosheng [0491 0948 0524]: "China To Implement Plan for Extending Application of Electronic Information Technology"]

[Text] The plan for popularizing and applying electronic information technology, which has been carried out in our country for many years, has now been upgraded as a national-level plan and named as the "multiplication plan." This is an important step and measure to promote the development of information technology for China's industries and social progress and the development of industrialization of information technology.

Application of electronic information is an important task. During the Eighth 5-Year Plan, China will conscientiously implement the policy of "grasping application and promoting development" and give full play to the role of electronic information as a multiplier so that application of electronic information can be pushed to a new and higher stage in various sectors of the national economy and social development.

The "multiplication plan" is a long-term plan for development and application of science and technology. It was put forth jointly by the State Council's Electronic Information System Popularization and Application Office and the State Science and Technology Commission, and the former is in charge of its formulation, implementation, and management. The implementation of this plan will promote the construction and application of the major information systems of the state. To promote the development of information technology in various industries, continuous efforts will be made to apply electronic information technology in various sectors of the national economy and social development. During the Eighth 5-Year Plan, it is necessary to further open up new projects for applying this technology and increase the level of application. Well developed technologies must be popularized and applied on a larger scale. The State Council's Electronic Information System Popularization and Application Office will cooperate with other relevant departments and, motivated by the government's preferential policies and new operational mechanism, will vigorously support the development of all kinds of information service trades. It will also promote the commercialization of information products and gradually realize industrialization of information.

1990's Identified As Crucial Years To Develop Microelectronics Technology

92FE0155C Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 18 Oct 91 p 2

[Article by Wang Yangyuan [3769 7122 0337], deputy director of the Ministry of Machine-Building and Electronics Industry Microelectronics Department: "The 1990's: A Key Period for Developing China's Microelectronics Technology"]

[Text] Abstract: China's first integrated circuit appeared in 1965, the same time that Japan got started, but later development slowed. The main reason was inadequate investments and a loss of control in macro policies. The 1990's are a key period for developing China's microelectronics S&T, and if our policies are correct, latecomers can surpass the oldtimers.

The development of microelectronics S&T is now changing society's production patterns and people's living patterns, and it is changing war models. It has not only become the foundation of modern S&T but is also creating a silicon culture, which is representative of the

information age. Thus, the development scale of the microelectronics industry and microelectronics S&T levels have become important indicators for assessing a country's economic strengths and technical progress. For this reason, every nation and region that wishes to stand tall in the world during the 21st Century is working to develop microelectronics industry and its S&T.

I. Fierce International Competition

Under the guidance of its "Semiconductor Promotion Law", Japan supported and organized an ultra-large scale integrated circuit technology research combination composed of five large enterprises from 1976 to 1980 and established a joint research institute that achieved major successes and laid a foundation for Japan to gain a position of advantage in IC production technology. Japan's investments in the IC industry and equipment now exceed its investments in the iron and steel industry and equipment. Given Japan's position of advantage in the area of IC production, the Japanese stated in the book "The Japanese Can't Say 'No'" that if the Japanese did not sell IC chips to the United States and sold them instead to the Soviet Union, this would change the balance of forces. In dealing with the victory of the multinational army led by the United States in the Gulf War, some Japanese feel that the United States could not have won this war without Japan's IC chips.

The United States implemented the Very High Speed Integrated Circuit Plan (VHSIC) in the 1980's and on the basis of investing $1 billion in capital and spending 10 years, it also established the "Semiconductor Technology" (Semitech) combine in 1986 that is composed of the 14 largest chip manufacturing companies and overall system companies in the United States. The objective was to develop 0.3 micron technology at a total budget of $1.5 billion. At the same time, the United States also implemented the "MIMIC" plan in the area of microwave monolithic ICs and millimeter-grade components and ICs and invested over $500 million on the goal of developing 1 to 100 GHz GaAs monolithic ICs. From 1990 to 1999, expenditures in the United States on military electronics equipment R&D and maintenance will exceed $500 billion, equal to 50 percent of total expenditures on weapons and equipment research, development, and testing. The recent report submitted to the President by the Congressional Semiconductor Advisory Commission, "A Strategic Industry in Crisis", focused on the gradually declining production of integrated circuits in the United States and the threat from Japan it was facing and warned: "if this industry, which is a matter of life or death, continues to decline, it will pose an unacceptable threat to the United States economy and national security."

Western Europe has absorbed its lesson of insufficient attention to microelectronics in the 1960's and early 1970's that affected the overall rate of industrial and S&T development, and implemented the Mega Plan in the 1980's. It also recently organized for implementation of the "European Joint Sub-Micron Silicon (JESSI)" Plan. Over 30 enterprises are participating in this plan with the goal of attacking key problems in 0.3 micron processing technology and producing 16Mbit and 64Mbit dynamic random access memory (DRAM) in 1993 and 1996.

South Korea raised $4.6 billion for a major effort to develop its microelectronics industry, represented by high-Mbit MOS DRAM and it will become the third largest semiconductor producing country in the world in the 1990's. This shows that the final decade of the 1990's as well as the entire 21st Century will be an era of competition of comprehensive national strengths and the key is S&T competition, whereas microelectronics S&T is the nucleus of this competition.

China's first integrated circuit appeared in 1965, the same time that Japan got started. China successfully developed its first 1024-bit MOS DRAM in 1975, some 5 years later than the Intel Corporation in the United States produced this type of product. Over the past 26 years, however, China's electronics technology has developed slowly. Our output, product varieties, and performance cannot compare with advanced international levels and we cannot satisfy the requirements of China's national economic and national defense construction. In looking for reasons, besides being restricted by overall development levels of the forces of production in China and the implementation of a technological blockade toward China by the Western capitalist nations, the main reason is that we have not handled matters in macro policymaking according to the objective laws of microelectronics S&T development requirements. Inadequate investments include insufficient one-time investments and the failure to make continual investments on the basis of the development schedules required for integrated circuits (usually 4 years). This is particularly true for our limited and severely scattered investments, "feudalistic" separatism in the management system, and an inability to attain the threshold of the requirements of scale production and R&D, which has caused severe waste. The industrial structure has not formed vertical enterprises based on the permeation, added value, and extension characteristics of integrated circuits, nor have we given full attention to opening up markets. Of course, since reform and opening up we have made some changes in this area and made definite achievements, but we still remain in a relatively backward state.

The 1990's are an important historical period in China's national economic development and the key decade for achieving our second strategic objective. China's industrial development should not and cannot follow the old route taken by the developed Western nations and cannot be achieved merely by relying on extension of the scale of traditional industry. The facts have proven that we should rely on S&T progress, broadly apply electronic information technology, increase the added value of products, raise labor productivity, take the route of intensive economic development, and shift the development of our national economy onto the track of relying

on S&T progress and improving the quality of laborers. It should be said that this is an even more magnificent and profound change. For this reason, developing the modern S&T of microelectronics is extremely urgent.

II. With Correct Policies, Latecomers May Surpass Old-Timers

For actual enterprises, although the development of microelectronics technology requires a rather large threshold as well as continual investments, in the overall sense the investments are not that large compared to traditional industry. If we can develop China's microelectronics using an investment equivalent to one-half of that for the Baoshan Iron and Steel Complex, there could be fundamental changes in China's microelectronics industry and its S&T and it could generate even more important benefits. Given our national strengths, there is also an objective possibility of developing microelectronics technology.

Briefly stated, microelectronics technology can be divided into two departments: 1) beginning with equipment and systems, using their requirements (information) to design tools to design (write) to semiconductor chips; 2) applying several types of special equipment, materials, and processing technologies to achieve and manufacture integrated circuits that include this "information". These two departments have different characteristics and the tactics that should be adopted are also different. The former stresses integration with equipment and systems and emphasizes permeation to form several design points that are integrated in a relatively scattered manner with equipment and applications markets. The development of design tools, however, should still be relatively centralized to continually outfit designers with advanced tools. The investments in this departments are not large, usually at the several million yuan level. For the technology, VHDL (VHSIC hardware description language) should be used to interface system designers and circuit designers. Technical standardization is used to establish all types of component stocks to serve as an interface between circuit designers and circuit manufacturers. The latter should adopt a "relatively centralized" processing method to establish IC chip processing lines that conform to market competitiveness and scale economy requirements and a standard technology processing line (Foumdary) [as published] that conforms to the requirements of small-batch multiple variety development and processing. Based on existing technology, the investment required for IC chip processing lines is generally $100 million while the products produced are $1 to $10, and their competitive cycle is generally about 4 or 5 years. This requires a production scale of about 10 million to 100 million circuits each year. Otherwise, it cannot become established economically. This means that a definite economic scale is still required for those products that use market opportunities to enter the market ahead of schedule and win higher prices ($100, for example). At the same time, there is a particular need for very powerful technical support to maintain the continual entry of this type of product. To establish a microelectronics industry that is based on China's own development, we must stress two points:

1. We must achieve coordinated development of materials and the matching special-purpose equipment and gradually achieve leading development. In a certain sense, without our own materials and special-purpose equipment industry, we can not have our own microelectronics industry.

2. We must adhere to S&T as the vanguard, have scientific research base areas that correspond to industrial base areas, and focus on basic research. Scientific research requires preparations and technological development requires deployments in depth.

Development of Marine High Technologies Seen Urgent

92FE0276F Beijing GUANGMING RIBAO in Chinese 12 Dec 91 p 2

[Article by KEJI RIBAO reporter Gu Xiaoxiang [7357 1321 5980] and GUANGMING RIBAO reporter Wu Yali [0702 7161 7787]: "Marine Development Should Go First To Fight for Riches from the Wave Bottoms and Early Benefits—The Urgency of Developing Marine High Technology in China"]

[Text] The vast seas contain substantially more treasures than the continents and are the second birthplace on which mankind will depend in the future. As a large marine country, we must start now in paying greater attention to developing marine high-tech and strengthen our sense of urgency in adopting high-tech to develop our marine "territory" to compete in the intense world-scale marine development and not fall behind. This was proposed by 20 experts from the Chinese Academy of Sciences and State Maritime Bureau on 9 December 1991 at the Marine High Technology Discussion Conference held at the behest of the State Science and Technology Commission.

According to information provided by the experts, the seas contain 60 quintillion tons of mineral resources, a total of more than 200,000 types of marine organism resources, and about 100,000MW in renewable marine energy resources. There are more than 82 chemical elements that can be extracted. The enormous space of the seas can also be utilized. This is particularly true starting in the 1990's, when the world's petroleum supplies are depending more and more on the petroleum beneath the seas.

Major problems facing the world like rapidly increasing populations, food crises, resource shortages, reductions in per capita land, and so on have led all the maritime nations of the world to vie with each other in developing marine resources. The experts said that the trend now is that whoever has the ability to develop them will be the one who benefits, whoever develops them soonest will be

the one who benefits first, and whoever uses high technology to carry out the most effective development will be the one who gains the maximum benefits.

China has 1.4 million square kilometers of offshore continental shelf that has been called a "cornucopia" and urgently requires high-tech for development. Regrettably, marine high-tech has not attained the corresponding status. China's State High Technology Research and Development Plan, which has been implemented for several years now, neglects the important realm of marine high-tech. The experts said that the seas are an extremely complex system and that in certain qualities marine high-tech is extremely similar to space technology in that it requires long-term technology reserves. For this reason, after the experts carefully analyzed China's economic strengths and existing technical foundation, they proposed the technological realms that should be developed first in the future: hydroacoustic technology, aerial-based marine remote sensing technology, deep diving technology, extraction and utilization technology, breeding and raising production technology, marine organism metabolic product development technology, and biotechnology in maritime environmental protection.

As a strategic measure, the experts proposed that a marine high-tech implementation plan be formulated as quickly as possible and that it be linked with the State High Technology Research and Development Plan. A second proposal called for establishing a state-level experts management commission to centralize scientific research advantages in all departments to improve the efficiency of research. A third called for providing the required expenditure inputs.

Promoting Naval Equipment Modernization by S&T Urged

Quality Construction Stressed

92FE0155I Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 28 Oct 91 p 3

[Article by Zheng Ming [6774 2494], director of the Naval Equipment Technology Department: "Rely on S&T, Promote Naval Equipment Modernization and Construction"]

[Text]

I. Strong Science and Technology Mean a Strong Military

The concept that "S&T are the first force of production" illustrates the huge role of S&T in promoting the development of forces of production and the economy and society and provides a profound enlightenment for reinforcing quality construction in China's military and increasing combat effectiveness.

While they were describing the role of S&T in developing forces of production, Marx and Engels also described the major impact of S&T progress on the military realm and pointed out the changes it would bring in military operations, command, and safeguard arrangements and in the various relationships within the military. Engels said that "during the 14th Century, gunpowder and firearms reached Western Europe and Central Europe and now, every elementary school student knows that this type of pure technological advance caused a revolution in all fighting methods". Marx pointed out that "with the discovery of new tools of war like shooting firearms, the overall internal organization of the military had to change, all those relationships that everyone used to organize an army and serve as military actions changed, and changes occurred in all relationships interrelated with the military". In these discussions one can see that even though at the time Marx and Engels could not have comprehensively and systematically described the relationship between S&T and military construction, the ideas of these revolutionary teachers in foreseeing the profound impact that S&T would have on military developments were truly clear.

In modern military combat and modern military construction, S&T are an important factor in improving the quality of military construction and combat effectiveness and may even be the key factor in determining victory or defeat in war. In the recent Gulf War, the multinational army held a position of extreme advantage in S&T and this must certainly compel us to look with new eyes at the role of S&T in modern warfare! With the rapid development of S&T and the widespread application of high and new-tech in the military realm, future military confrontations will primarily be manifested as confrontations in the military S&T realm and manifested as confrontations in the struggle for S&T advantages. Without being outfitted with highly-developed S&T, an army does not have the qualities of a modern military and thus has no combat effectiveness and will be backward and bullied. "Strong S&T mean a strong military" has been increasingly confirmed as a truth by practice in modern military struggles.

In this new historical era, the primary contradiction in China's military construction is the contradiction between the objective requirements of modern warfare and the relatively low levels of modernization in China's military. For this reason, for a period into the future the basic principle in China's military construction will be to further raise revolutionary, modernization, and standardization levels, accelerate development in the direction of high- tech weapons and equipment, and take the path of focusing on quality to build crack troops. With a prerequisite of adhering to revolution, apply S&T to reinforce quality construction. In this sense, the route of using quality to build our military and have crack troops is in essence the route of using S&T to strengthen our military.

First, in regard to improving the quality of "people", comprehensive improvement of the political, military, and technological qualities of members of the military, in particular commanders and fighters, is the primary

factor in strengthening quality construction. With a prerequisite of adhering to political qualifications, only those who understand S&T and have specific S&T educational knowledge can have relatively powerful military qualities.

Second, in regard to improving the quality of weapons and equipment, the development trends of modern weapons and equipment are embodied in the shift from thermal weapons to high-tech weapons. The propulsive force for achieving this transition comes from advances in microelectronics, computers, new materials, new energy resources, nuclear technology, and other areas and has moved weapons and equipment into the new stage of intelligence, precision guidance, deep casualties, automation, systemization, and electronics, which has greatly increased combat strength and existence capabilities.

Third, in regard to improving the quality of integration of man and weapons, this also cannot be separated from modern military science and modern military management technology. It requires changes and readjustments based on the development of modern weapons and equipment in military organizational structures and system compilation and management mechanisms, in combat, command, safeguards, operational patterns, and all the relationships within the military in order to select optimum arrangements for integration of man and weapons to attain the maximum benefits from the use of weapons.

For more than 40 years, China has made huge achievements in developing national defense S&T and weapons and equipment. Regarding the development of naval equipment, however, we have moved from capture and renovation to acceptance and purchasing, and transfer and manufacturing to copying and importing and self-development. This is particularly true of our efforts to increase our modern maritime fighting capabilities in recent years in which breakthroughs have been made in several projects that have gradually moved naval weapons and equipment into a new stage of modernization and construction.

At the same time, we have also seen that China's naval weapons and equipment development levels lag substantially behind the militarily developed countries of the world and that we are still far from high quality and high-tech requirements. Thus, we must resolutely take the path of using S&T to strengthen our military and combine reinforcement of revolutionary construction in China's military with a high degree of attention for and development of S&T to improve our weapons and equipment and comprehensively reinforce quality construction and increase combat effectiveness.

II. Use the Ideology "S&T Are the First Force of Production" To Guide Naval Equipment Construction

Naval equipment construction is an important part of achieving naval modernization and strengthening naval quality construction as well as the key to improving our naval combat effectiveness. For a period into the future, we will be in a key period of gradual updating and replacement of naval weapons and equipment and echelon development, so the tasks will be extremely heavy. We must understand the role of S&T in naval equipment construction from strategic elevations, establish the concept of using S&T to strengthen our military, and promote modernization and construction of naval equipment.

A. We must resolutely take the route of relying on S&T for quality construction of our military from the elevation of "the first force of production".

A navy is a type of military with very powerful technological qualities and the development of weapons and equipment requires substantial investment of funds. In the present situation of being unable to make significant increases in national defense expenditures, the basic method for solving this contradiction is to adhere to the development principles for quality construction of our military of reducing battlelines, focusing on breakthroughs, reinforcing scientific research, and echelon upgrading. Adherence to this principle requires that we continue to deal properly with four relationships in naval equipment construction. One is the relationship between the urgent needs of combat readiness and long-term construction. The second is the relationship between upgrading our equipment in active service and developing new equipment. The third is the relationship between importing and domestic production. The fourth is the relationship between reliability and advanced qualities. Correctly dealing with relationships in these four areas is a summary of experience in naval equipment technology work and a reflection of the objective laws of naval equipment development for a substantial period, and it is a concrete embodiment of the principles of quality construction of the military and using S&T to strengthen our military in the naval equipment technology realm.

B. Strengthen the S&T consciousness of leading cadres, truly place S&T work in an important status.

Leading cadres at all levels in the naval equipment system must first of all strengthen their consciousness of, concern for, and attention to S&T and support and develop S&T work. The S&T consciousness of leading cadres should primarily be manifested in these areas: 1) An understanding of the urgency of upgrading. They should take note of the burgeoning development of modern S&T and the gradual discarding of old knowledge. If they fail to grasp new scientific knowledge, they will be unable to catch up with the pace of the era and cannot be S&T leading cadres of the first rank. 2) A sense of crisis regarding a dangerous situation. They should take note of the tremendous lag of our weapons and equipment behind the weapons and equipment of the world's developed nations and always be vigilant that "backwardness means being bullied". 3) A sense of mission regarding the development of naval equipment.

They should always be aware of the heavy responsibilities and burdens they bear, wholeheartedly throw themselves into naval equipment construction, and dedicate themselves to contributing to naval equipment modernization. 4) A relatively strong consciousness of information and intelligence. Modern leaders must be capable of seeking out, organizing, and using information and intelligence, pay close attention to the development situation of world S&T and high-tech weapons and equipment, and serve scientific policy-making.

C. Be concerned with S&T cadre staff construction, train "red and expert" personnel for this and the coming century.

Regarding the naval equipment system, during the next 3 to 5 years a substantial portion of elderly comrades involved in equipment work will retire and the heavy tasks of naval equipment modernization and construction will fall onto the shoulders of young people. Now, we must resolutely focus on training successors for this century and into the next one, focus on the present and look toward the future, and train a generation of personnel, forge a group of people, create "members of a squad", and ensure the flourishing development of the cause of naval equipment construction. We should focus on the planned training of industrial management experts, specialized technical authorities, and other specialized personnel, and in particular should be concerned with training superior quality young personnel. We are planning to adopt seven measures: 1) Establishing a scientific research fund for young people. Propose scientific research projects based on the work requirements of young S&T personnel at their posts and provide them with focused support. 2) Establishing a superior quality personnel archive database. Include S&T personnel who have made prominent contributions to equipment scientific research and received national S&T awards in the superior quality personnel archives database and give them preferential consideration in utilization and training. 3) Developing "successors" activities led by "current personnel". All industrial experts, technical authorities, and comrades with high-level technical job titles should guide a middle-aged or young S&T personnel with training and development prospects and make the situation in transferring assistance and leadership an important aspect of evaluation. 4) Providing commendations and awards to departments, units, and leading cadres who have made significant contributions to the training of young S&T personnel. 5) Using various arrangements for active propaganda concerning the advanced achievements and technical accomplishments of naval S&T personnel, increase their recognition within and outside of the military, and stimulate the spirit of making advances for all S&T personnel. 6) Reinforcing on-the-job training, implementing training in replacement posts, paying attention to knowledge updating, and improving the political and professional qualities of S&T personnel. 7) Emphasizing improvement through study in actual work involving equipment scientific research, observation of manufacturing, inspection and acceptance, and other actual work, taking the initiative in giving young S&T personnel heavy burdens and building ladders, trying to create an excellent environment for all S&T personnel to be able to make use of their intelligence and grow in a healthy way. In addition, we will implement fixed posts and fixed positions according to industry for S&T personnel and further improve the working and living conditions of S&T personnel.

D. Further intensify reform of equipment technology work, strengthen scientific management.

During the Seventh 5-Year Plan, we should begin with the three areas of strengthening quality construction, improving economic results, and reinforcing management of the legal system, actively explore reforms in naval equipment technological work, make major efforts to promote systemization of weapons and equipment, conscientiously implement management by objectives and other scientific management methods, and actively explore a system under directive-type plans. Bring bid solicitation and competitive mechanisms into equipment development, foster the regulatory role of economic levers in scientific research management. Have strict macro regulation and control in equipment technology work, implement "four examinations" procedures for examining projects, examining blueprints, examining prices, and auditing, reinforce total-system quality supervision throughout the entire process of equipment development and production, actively and stable carry out reforms in management mechanisms, take the initiative in "extending forward and backward" in equipment technology work, reinforce construction of the legal system and regulations, make significant achievements in all areas, create a new situation in equipment technology work, enable naval scientific research to develop more, and enable the management system and technology development mechanisms to display flourishing vitality. To complete all future tasks for naval equipment development, we must still adhere to the ideology of reform and opening up, continue to intensify reform on the basis of consolidating reform achievements during the Seventh 5-Year Plan, and further create an excellent environment that promotes the development of naval equipment technology work.

For a period into the future, the directions and primary content of intensive reform of the naval equipment system are:

1) Focus on quality construction, truly reinforce quality supervision centered on reliability, work in strict accordance with the three requirements of standardization, systemization, and interchangeability, raise equipment reliability, maintainability, and supportability levels, strengthen consciousness of full-lifespan management, full-process control, and full-system synchronized deployments, reinforce synchronized construction, and ensure that new equipment forms combat effectiveness as quickly as possible after being turned over.

2) Strive to improve military economic benefits, further explore military product ordering laws in the new situation, adhere to the "four examinations", explore and perfect management routes to make our limited equipment funds foster the maximum application benefits, and reinforce utilization management and supervision of naval equipment purchasing and scientific research expenditures in the system area.

3) Promote the development of equipment technology work in the direction of standardization and systemization, continue to perfect model development, equipment ordering contracts, and other systems, continue to focus on reform of the naval equipment technology management system, and continue to strengthen standardization construction focus on legal system construction.

We believe that under the guidance of the correct strategic principles of the Central Military Commission and Navy CPC Committee and by adhering to reliance on S&T progress and arduous struggle, naval equipment construction will certainly achieve substantial development. In the not too distant future, a crack Chinese navy with a modern combat capability will certainly appear on the Pacific Ocean.

Naval Equipment Manufacture

92FE0146A Beijing JIANCHUAN ZHISHI [NAVAL AND MERCHANT SHIPS] in Chinese No 8, 8 Aug 91 pp 2-3

[Interview by JIANCHUAN ZHISHI reporter Xiao Jun [2556 6511]: "S&T and China's Naval Equipment Construction—Naval Equipment Technology Department Director Major General Zheng Ming [6774 2494] Answers JIANCHUAN ZHISHI Reporter's Questions"]

[Text] During the Fourth National Science Congress, I visited China Shipbuilding Engineering Society deputy director and Naval Equipment Technology Department director major general Zheng Ming. Director Zheng answered my questions concerning China's naval equipment development and construction and I am now publishing a portion of the record of my visit.

Reporter: Director Zheng, as a delegate to this congress, could you discuss the relationship between S&T and national defense construction, in particular naval construction.

Director Zheng: I feel that I have received a substantial education and encouragement from participating in this congress. Comrade Jiang Zemin described the doctrine and theory of Marx, Mao Zedong, and Deng Xiaoping that "S&T are a force of production" in his speech at the opening of the congress and illustrated the role of S&T as the first transformation in the development of the forces of production and the development of society and the economy in the present age. This has profound significance for China's socialist modernization and construction. As a member of the navy as well as an S&T worker, I feel that to have a profound understanding of the doctrine that "S&T are the first force of production" and to conscientiously adhere to it in work, I must first of all have a scientific attitude in understanding the relationship between S&T and the activities I am involved in. I feel that the development and evolution of military equipment and technology in national defense construction depends on the level of S&T development. The development of S&T promotes the development, updating, and replacement of military weapons and equipment while at the same time changing military doctrines, strategy and tactics and affecting the scale and levels of national defense construction. Of course we cannot neglect the requirements of war or the guidance of military ideology, which are even more basic motive forces that pull and spur the development of S&T.

Naval construction is an example. The navy is a branch of the military which has a wide variety of technological categories, intensive knowledge, and numerous specializations and naval technology is characterized by broad compatibility, rapid updating, great difficulty, and powerful comprehensiveness. High and new technology often plays faster and more numerous roles in the navy. There is a close relationship at present between the development and updating of China's naval weapons and equipment and the newest S&T achievements in China's national defense S&T industry. I feel that development levels for naval technology are one of the primary indicators of a country's military strength and even overall national strengths.

Reporter: Many armed conflicts and local wars have occurred in the world during recent years in which navies participated. What revelations do they have for the development of China's naval equipment?

Director Zheng: For the past 10 years, several 10 armed conflicts and local wars on varying scales have occurred in the world and many of them involved navies. The main maritime wars on a large scale were the 1982 conflict between England and Argentina over the Malvinas [Falklands] Islands and the Gulf War in 1991. Of course, both of these wars were local wars conducted under special conditions, on a unique background, and with unique objectives, but they still provided substantial enlightenment for naval equipment construction. This is particularly true for the combat effectiveness embodied in many high, precision, and incisive weapons during the Gulf War, which has given us a greater understanding of the role of S&T in modern warfare. Although we believe that men and not materials are the ultimate determinant of victory or defeat in war, we must respect science and be concerned with developing our own advanced weapons and equipment. I feel that R&D in the realms of national defense S&T and naval equipment development should be on several key and unique "killer mace" technologies.

Reporter: The world's naval equipment and technology are developing so quickly now. Does this put pressure on China's navy? How does the Chinese navy play to speed up the development of its own weapons and equipment?

Director Zheng: Of course it places substantial pressure. This pressure comes from the constant new developments of naval equipment and technology in the world and even more from an analysis of the international environment and strategic deployments. At present China still faces a serious situation toward the sea, so to protect China's maritime territorial rights and safeguard China's maritime rights and interests and to conduct active defense to prevent encroachment from outside, we must start with China's national conditions and establish a powerful revolutionary, modernized, and standardized people's navy. In the area of naval equipment strategies, the focus is on developing submarines, missile warships, and marine fighter aircraft.

How can we speed up the development of weapons and equipment for this navy? I feel that first we should follow the line of seeking truth from facts and take a route with Chinese characteristics. Navy commander Zhang Lianzhong [1728 6647 1813] has dealt with this line and route in four relationships within equipment construction: 1) the relationship between urgent needs at present and long-term construction; 2) the relationship between the advanced properties of equipment and reliability; 3) the relationship between importing equipment and a shift to domestic production; 4) the relationship between in- service equipment and developing new equipment. I feel that if we deal properly with these four relationships we will certainly be able to take a naval equipment construction route with Chinese characteristics, focus on quality construction of the military, and use S&T to strengthen our military.

Reporter: You just said that the navy is an S&T-intensive branch of the military. What significance does tracking world high-tech developments have for naval equipment construction?

Director Zheng: General secretary Jiang Zemin pointed out in his speech at this congress that "in essence, international competition is competition of comprehensive national strengths; those who are backward in S&T will be passive and bullied". As I understand it, this refers to economic construction as well as national defense construction. We have a definite foundation and capabilities in the area of naval equipment scientific research but our research measures and production facilities in naval equipment and shipbuilding S&T must be updated and upgraded. Otherwise, we will be unable to take on the task of tracking world high and new-tech and the lag of our naval weapons and equipment behind advanced world levels will grow instead of shrink. This does not conform to China's national development strategy or China's national status and we are unable to satisfy the warfare needs that our navy may face in the future. In this sense, tracking world advanced high and new-tech is an important guiding principle and an important step for naval weapons and equipment construction.

Reporter: What are China's present naval equipment levels in international terms?

Director Zheng: Before discussing this issue, there is one point I would like to explain. The foundation of China's naval weapons and equipment construction was very weak and the starting points were extremely low. In the 40-plus years since the founding of the People's Navy in 1949, under the guidance of the CPC Central Committee and Central Military Commission, and through the direct organization and implementation as well as major efforts at coordination by state industrial and S&T departments, naval equipment construction has gone through the five phases of capture, renovation, and refitting of old naval vessels and aircraft; using received materials to design and build our own naval vessels; importing technology and equipment for transfer manufacturing; copying and improving; and designing our own complete sets of equipment for weapons and equipment. We have relied on our own efforts to complete the development of first and second-generation weapons and equipment and to provide weapons and equipment representative of China's S&T and industrial levels for establishing a maritime fighting force composed of the five branches of submarines, surface vessels, airborne troops, ground troops, and coastal defense troops. Long-distance sailing and examination in practice have proven that this equipment has combat effectiveness. Because of the low starting point and weak foundation in the development of naval weapons and equipment, however, our present weapons and equipment still lag substantially behind the world's advanced equipment. With the further development of national economic construction, however, we have made continual investments in the development, production, and outfitting of our military using a new generation of naval weapons and equipment and I believe that the pace of modernization and construction of naval equipment will be accelerated up to around the year 2000 and that there will be substantial improvements in technical levels.

Reporter: I heard that you have made several reform proposals in the areas of naval vessel design and equipment management that have received a response from shipbuilding S&T circles and support from the relevant areas in the national defense industry. Could you describe them? What is the relationship between these proposals and the doctrine that S&T are the first force of production?

Director Zheng: There are not really proposals, just some ideas and summaries I have gained in the process of working jointly with experts, S&T workers, workers, cadres, and naval commanders involved in naval equipment development and through the study of much S&T knowledge and scientific management experiences, and they have been included in several actual technology policies. An example is the proposal of the "two capabilities and six properties" design principle in naval vessel design, and so on. The "two capabilities and six properties" in naval vessel design refers to fighting capabilities and existence capabilities, serviceability (including reliability, maintainability, and supportability), mobility, concealability, compatibility, economy,

and livability to serve as systems engineering factors for comprehensive optimization of designs. China's naval development and design work employed a transfer manufacturing arrangement after the 1950's and totally absorbed the design ideas and principles of the Soviet Union at that time. Beginning in the 1960's, to adapt to the development requirements of the new situation, besides suggesting the need to be concerned with traditional technological performance in naval vessel design, we made successive proposals concerning the need for attention to reliability, electromagnetic compatibility, concealability, livability, and other new concepts. These views began to attract universal attention and with design practice and intensification of the policy of reform and opening up, naval vessel design ideas began taking into account the common understanding of the trend of reform by most people. The proposal of the "two capabilities and six properties" principle outlined the design and development experiences for multiple models of naval vessels in the navy and brought in the military standards of the navies of the world's advanced nations and new concepts in naval vessel design, development, purchasing, and testing. It was a transition in naval vessel design ideas for China's navy and was extremely necessary for raising naval vessel starting points, design levels, and combat effectiveness.

Another thing was the undertaking of the "four examinations" work procedures in naval equipment management and adherence to the "three totals and three changes" management principles. In naval equipment scientific research development and administrative management, scientific decision-making was used at every level for the four examinations procedures involving examination of projects underway, examination of design blueprints, examination of prices set for military products, and auditing of equipment finances. The principles of comprehensive quality management were applied in a concrete way in naval equipment construction as "total-lifespan management, total-process control, and total-system synchronized construction" along with reinforcement of "standardization, systemization, and interchangeability", all of which embodied the application of the new technology of scientific management and scientific control. There have been substantial developments in naval equipment scientific research over the past several years and practice has confirmed the important intensive role of bringing in S&T to enrich the forces of production. In the future, we must more self-consciously understand and adhere to the doctrine that "S&T are the first force of production" and we will be able to make even greater achievements in naval equipment construction.

Reporter: You mentioned the substantial achievements made in more than 40 years of construction in the People's Navy, and you mentioned the fact that naval equipment and technology levels in China still lag considerably behind advanced international levels. What are your ideas on this?

Director Zheng: Reviewing the history of naval equipment development and looking at the magnificent strategic objectives for national development by the year 2000 formulated by the party, I have full confidence that our naval equipment and technology will catch up with advanced world levels. Of course, this does not mean that naval equipment modernization can accomplish this in one move. Instead, it will require arduous struggle and unremitting efforts for generations of people, including ourselves.

Finally, I would like to mention that over the past several years, many of the masses and even elementary school students have written senior naval officers and navy leadership organs, and some have even sent donations. They want China's navy to be even more powerful and express their innermost feelings regarding their willingness to help in China's efforts to build its own aircraft carrier. During the 1990 National Young People and Children's Naval Vessel Knowledge Competition Dalian Finals, we were contacted by over 50 young people and children's winners who truly embodied the concern of ever- increasing numbers of young people and children for the oceans and for the naval and shipbuilding industry. Some of them were resolved to build large ships and create military vessels for the motherland and some resolutely wanted to join the navy and dedicate their lives to protecting the motherland's sea frontiers. This was extremely moving to an old sailor like myself and I was extremely encouraged. I firmly believe that there is great hope for the successors in our cause. We old sailors and old shipbuilders must work harder at our posts to deserve the support we have been given by the broad popular masses and young people and children and to fulfill the hopes that the party and state have for us.

[Photo caption]: Major general Zheng Ming and scientific research personnel study the development of naval equipment.

Technology Diffusion Considered Key to Military-Civilian Technology Transfer

92FE0215H Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 2 Dec 91 p 3

[Article by Mu Rongping [4476 2837 1627]: "Technology Diffusion—The Key to Conversion from Military to Civilian Products"]

[Text] Today, with peace and development as the main currents in the modern world, achieving a conversion from military to civilian products and fully fostering the potential and advantages of China's national defense S&T industry have become a national policy that has received wide support from all social circles. We feel that achieving this objective requires a high degree of attention to the key link of technology diffusion.

I. The Economic Significance of Technology Diffusion

Technology diffusion refers to the continuing utilization of an innovation following its earliest commercial application. This includes other users who obtain this innovation as well as expanded uses by the original innovator. It also includes all types of activities by enterprises or other organizations in exploiting the economic benefits of the innovation. It is a process of accumulated improvement and perfection over a long period. The development and diffusion of a new technology are two phases of technological change. The former stresses the provision of a new technology while the latter stresses the continual utilization of a new technology, and both have great economic significance. The relevant research has shown that although investments in the new technology development area can move certain important new scientific advances into the market and create income, the speed and scope of adopting new technology and using this technology in commodity production is much more important that technology development in improving productivity and competitiveness, improving product quality and variety, and other areas. In fact, most profits arising from technological changes are earned by early innovative imitators or users. Several studies in the United States on innovative proposals show that the average return to enterprise investments in new products or new technology is 55 percent, whereas the average return to enterprise investments involved in developing and marketing innovations is only 22 percent. The research results also showed that there is an even greater difference between the incomes earned from diffusion and development of relatively important innovations. Moreover, it is usually the case that less capital is required for technology diffusion than for technology development and the risk involved in technology diffusion investments is less than the risk for technology development investments. Thus, in a situation of inadequate resources, it would be better to meet the resource needs of technology diffusion.

II. Technology Diffusion in Conversion From Military to Civilian Products

The focus in conversion from military to civilian products in China is changing from the past situation in which the national defense S&T industry only served national defense to one of service to the four modernizations. Concretely speaking, there are three objectives in conversion from military to civilian products:

First is fostering the advantages of the national defense S&T industry in the areas of skilled personnel, technology, testing measures, production facilities, technology development, and so on and using diffusion of advanced technology to upgrade traditional industry. Because of its technological backwardness, low efficiency, and in particular its use of large amounts of outdated equipment and technology, it is very difficult at present for China's traditional industry to get out of its situation of relying on increased inputs of capital and energy resources and extensive development. Further development also depends on injecting new technology into traditional industry and raising management levels.

Second is satisfying the ever-growing domestic demand for civilian goods and consumer products and accumulating capital for scientific research, technology development, and technology diffusion. Although our present consumption levels are considerably lower than in the developed countries, there is still very substantial total domestic demand.

Last is actively opening up international markets, promoting technology and product exports and importing, digestion, and absorption of key technologies, and thereby achieving technical upgrading in the national defense S&T industry itself as well as in traditional industry.

Although China's national defense S&T industry has produced enormous economic benefits in shifting its production capacity toward production of civilian products as part of the shift from military to civilian products, there is sometimes a struggle of products and competition for markets between the national defense S&T industry and civilian industry. Thus, a shift of production capacity in military industry enterprises to conventional consumer goods or even conventional "long line" goods [goods that are in abundant supply] should not be a primary goal in conversion from military to civilian products. Instead, there are even brighter prospects for serving the national economy by adopting technology diffusion patterns in converting from military to civilian products. From the perspective of technology supply, on the one hand the present capital situation makes it difficult to bear the burden of increasingly enormous technology development expenditures, so conversion from military to civilian products should not rely on technology development but should instead be based on diffusion of existing technology. On the other hand, China's national defense S&T industry has seen more than 40 years of high intensity investments and it has accumulated a great deal of national defense technology and experience in making their own development decisions. These highly useable and functional, highly systematic, and reliable national defense technologies have made China's national defense S&T industry an important source for technology diffusion. From the perspective of technology utilization, because of unequal development of S&T, there are substantial differences in the levels of the technology adopted by each department, so technology diffusion is the key to taking advantage of national defense S&T industry and achieving conversion from military to civilian products.

Classified according to the type of technology, technology diffusion as part of a conversion from military to civilian products includes tangible and intangible technology diffusion. The former refers mainly to the diffusion of actual production equipment and technology while the latter refers mainly to the diffusion of management technology and other related soft technologies. Divided according to region, technology diffusion as

part of the conversion from military to civilian products includes two areas, diffusion of national defense and military industry technology toward civilian industry and diffusion of advanced technology.

Diffusion of national defense and military industry technology into civilian industry fosters the national defense and military industry technological advantages that have been accumulated by the national defense S&T industry over the past 40-plus years, especially in realms like nuclear power, aviation, space, microelectronics, systems engineering, and so on. In the past, because of the effects of the policy of closure, the unique technological advantages of the national defense S&T industry were never fully fostered. Moreover, because of its low productivity, outdated equipment, and backward technology, traditional industry was uncompetitive. In a situation of capital shortages, it obviously is unrealistic to quickly replace all backward equipment, so we can only rely on diffusion of national defense and military industry technology into civilian industry and use the development of new products and upgrading of old equipment to improve equipment functions, increase production capacity, and conserve energy. There are three main forms at present for the diffusion of national defense and military industry technology into civilian industry: 1) Single-item technology that is directly used in production. An example is timing technology used in recovering satellites that is directly used in household appliance production. It improves product quality and does not require imports. Another example is superfine aluminum powder preparation technology, which has extremely broad applications prospects in automobile and household appliance spray painting technology. 2) Simultaneous use of several technologies to develop a single type of civilian product. 3) Analogous use of the principles and methods of national defense and military industry technology in civilian industry.

Diffusion of advanced technology involves the advantages of the national defense S&T industry in areas like skilled personnel, technology, experimental equipment, production facilities, capacity for making their own development decisions, and so on, especially in the nuclear power, aviation, space, microelectronics, precision processing, and other fields. Although many high and new technologies have been developed over the past 40-plus years, they are still unable to meet the requirements of the national defense S&T industry and technical upgrading in traditional industry. This is especially true for key technologies, which are in urgent need of updating and replacement. For this reason, in a certain sense the focus of technology diffusion in converting from military to civilian products should be advanced technology, particularly key technologies, so that they are quickly diffused and produce the greatest economic benefits. Of course, this sort of technology diffusion requires very powerful technology tracking and evaluation capabilities as well as substantial capital support. Thus, it can only be carried out in fields where the national defense S&T industry has definite advantages.

III. Impediments to Technology Diffusion in Conversion From Military to Civilian Products and Countermeasures

The impediments to technology diffusion in conversion from military to civilian products are manifested first of all in the long-term neglect of the economic significance of technology diffusion in the state's policies. For a long time, China has accepted a linear model of technological change and considered technology development to be successful commercialization, successful application, and deriving the precursors required for profit. As a result, we have given preference to arranging technologies, developing what is needed, and stressing the provision of new technologies in resource deployments and neglected the resource deployments required for technology diffusion.

The second impediment to technology diffusion in converting from military to civilian products is mutual closure and an impeded flow of information among departments. For a long time, the administrative departments in charge of national defense and military industry technology development were not concerned about how to diffuse this technology into civilian industry, while civilian industry that needed advanced technology also found it hard to approximate national defense and military industry technology. As a result, it was hard for many national defense and military industry technologies to play a role.

The third impediment to technology diffusion in converting from military to civilian products is the pursuit of utilization functions and neglect of producibility for military industry technology. As a result, there had to be secondary development of military industry technology when it diffused into civilian industry. The high cost and great risk involved in secondary development of military industry technology made many enterprises unwilling to become involved. The result was considerable difficulty in diffusing these technologies, and a similar situation often appears in the diffusion of relatively complex national defense and military industry technology.

On the basis of the preceding analysis, I offer these suggestions to overcome impediments to technology diffusion in conversion from military to civilian products:

1. State policies should pay attention to technology diffusion and in particular should be concerned with supporting the diffusion of national defense and military industry technology into civilian industry and provide the required slant in resource allocations.

2. Organize special organizations to be responsible for national defense and military industry technology information research, management, and consulting, promote information exchanges between the national defense S&T industry and civilian industry, and accelerate the diffusion of national defense and military industry technology into civilian industry.

3. The state should provide preferential capital support for secondary technology development required for diffusion of national defense and military industry technology into civilian industry.

4. Encourage civilian industry to invest in diffusion of military industry technology into civilian industry and create an excellent economic environment to stimulate even greater accomplishments in technology diffusion in the national defense S&T industry and civilian industry.

Advanced National Defense S&T Classification Documentation System Established

92FE0215F Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 23 Nov 91 p 1

[Article by Jiang Qingwei [1203 7230 0251]: "China Establishes Advanced National Defense Science and Technology Classification System That Is Playing an Active Role in Important Scientific Research and Experimentation Fields"]

[Text] After more than 30 years of efforts, the National Defense Science, Technology, and Industry Commission has established a preliminary advanced S&T classification system that is playing an important role in scientific research and experimentation on the development of China's satellites, guided missiles, and conventional weapons. I learned this at the National Defense Science, Technology, and Industry Commission's First Classification Work Conference that was held today.

To meet the development needs of incisive national defense S&T activities, the National Defense Science, Technology, and Industry Commission has established a series of high-quality archive management systems as well as advanced automated facilities for searching, categorization, data transmission, and so on. They have now found out about and formulated over 300 laws concerning classification and established several 100,000 important S&T archives and more than 400,000 valuable pieces of photographic information of various categories, which has contributed to the protection of important national defense scientific research achievements and received many commendations from the Headquarters of the General Staff.

For the past several years, national defense S&T classification work has provided active service to China's nuclear technology, aerospace, ordnance, and other important scientific research realms and produced significant social and economic benefits. Over 40,000 people from inside and outside the military have been received, more than 80,000 S&T archives of various categories have been provided to the relevant departments, and they have played an important role in national defense scientific research and experimentation, administrative management, territorial surveys, real estate checks, and other areas. In construction of the large-scale launch work site at Xichang Satellite Launch Center, they immediately provided large amounts of S&T information to design departments that enabled design and construction units to complete in just 1 and ½ years a project that the developed countries took 2 and ½ years to complete and created the conditions for Chinese space technology to enter the international market.

At the conference, National Defense Science, Technology, and Industry Commission vice chairman Shen Rongjun [3088 2837 7486] summarized the basic situation in adherence of the "Secrecy Law" and "Archives Law" and deployed future tasks, and Xing Yongning [6717 3057 1337] of the Political Commission proposed requirements on how to do better classification work.

Ministry of Aerospace Industry Exploring Transition to Civilian Products

92FE0114F Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese 5 Oct 91 p 1

[Article by reporter Hao Meifang [6787 2734 5364]: "Actively Exploring Optimum Arrangements for the 'Transition from Military to Civilian Products', Ministry of Aerospace Industry Institute 502's Kangtuo S&T Development Company Is Applying Many High-S&T Achievements in National Economic Construction"]

[Text] The Ministry of Aerospace Industry's Institute 502, which is involved primarily in spacecraft attitude and orbital control research, design, and production is actively exploring optimum integrated arrangements for the "transition from military to civilian products" and established the Kangtuo S&T Development Company, a "civilian product" development unit in which research personnel, senior engineers, graduate students, and undergraduate students are the main force. For the past 3 years, this company has successfully applied several high-S&T achievements in national economic construction, gradually achieved a scale and industrialized them, and thereby used its unique S&T advantages to squeeze into the ranks of the 30 leading key enterprises in the Beijing Municipality New Technology Industry Development and Experiment Zone.

S&T levels in China's military industry realm are high and technical forces are strong. If this high technology could play a role in national economic construction, it would generate enormous economic and social benefits and could even transform the backward situation in industry. Practice by the more than 100 employees of the Kangtuo S&T Development Company provides full confirmation of this point.

The STD industrial controller developed and produced by the Kangtuo S&T Development Company is an example. This product and technology were originally used in satellite operation and orbital control. Kangtuo S&T Development Company successfully applied it in the iron and steel metallurgy, numerical control machine tool, electromechanical equipment, petrochemical industry, pharmaceutical, food product, and many other realms. The value of output from this product alone is as much as 20 million yuan. In competing with similar

products throughout China, the STD5000 series industrial controller has gained an absolute advantage due to its advanced technology, full set of equipment, strict quality control, and other aspects. It has been included as a national-level major new product, a superior machine type of industrial controller by the Ministry of Machine-Building and Electronics Industry, and a state-level "Torch" project.

With the development of economic construction, the safety and reliability of railroad transportation are becoming increasingly important. To prevent the occurrence of train "hot axle" overturning accidents, scientific research personnel at Kangtuo S&T Development Company integrated infrared technology with STD industrial control systems and developed a miniature far-infrared hot axle automatic measurement system and extended and applied it. It is playing an enormous role in railroad transport safety.

To improve the quality and increase output of antibiotic fermentation, Kangtuo S&T Development Company cooperated with Harbin Pharmaceutical Plant to use the mature STD5000 industrial controller and successfully developed an antibiotic fermentation technical process measurement and control system that raised the input/output ratio of antibiotic fermentation to 1:6 to 1:9 and increased output by 25 percent. The State Science and Technology Commission has now made this scientific research achievement a key extension project.

A large airport oil storage and oil supply miniature monitoring and control collection and distribution system is another applied technology developed by Kangtuo S&T Development Company. On the eve of the 11th Asia Games, this monitoring and control system was formally used at the Beijing Airport. The facts have proven that the monitoring and control system developed by Kangtuo Company is advanced, accurate, reliable, economical, and in no way inferior to products from foreign countries.

The extension and application of high S&T brings high benefits. Kangtuo S&T Development Company general manager Qin Ge [4440 7245] said that Institute 502 has over 100 scientific research achievements each year and has adopted the "one institute, two systems" in using a company arrangement to establish a military product staff that forms an optimum system with "two fixed heads and an intersecting middle". The advantages of this system are that the company destroys the "iron rice bowl" and adopts flexible operational mechanisms to participate in fierce market competition, while the research offices in the institute are powerful backup forces that continually promote new products for the company, so that the two advantages "complement each other" and benefit the industrialization of high S&T.

Kangtuo S&T Development Company has successfully fused its industrial controller, programmable controller, intelligent controller, bus network technology, communications technology, and software technology into a single entity and formed powerful technical advantages, and it has promoted several "fist" products. It just 3 years, Kangtuo Company has completed a gross income of 58 million yuan from technological and industrial trade.

Aeronautics and Astronautics Ministry Sets S&T Goals

92FE0401C Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 6 Feb 92 p 1

[Article by Correspondent Wang Hanlin [3769 5060 2651]: "Ministry of Aeronautics and Astronautics Sets Technological Progress Goals. Upgrading of Military Aircraft; Major Breakthroughs on Civilian Aircraft; Research and Development of New Generation of Strategic and Tactical Missiles; and Improvement of Satellites and Carrier Rockets"]

[Text] Minister of Aeronautics and Astronautics Lin Zongtang [2651 1350 2768] made the following remarks a few days ago at the conclusion of the fourth work conference. The main tasks of the aeronautics and astronautics industry during the Eighth 5-Year Plan are "three breakthroughs and one increase." This means doing all possible to maintain momentum for development of high technology in aeronautics and astronautics, and to make new breakthroughs; continued major efforts to advance the strategic change from military to civilian, and to make new breakthroughs; and further increase in economic returns while ensuring quality. Main combat goals are "upgrading of military aircraft, major breakthroughs on civilian aircraft, research and development of a new generation of strategic and teactical missiles, and improving satellites and carrier rockets."

Lin Zongtang said that 1992 is the most strenuous year in the history of the aeronautics and astronautics industry for research and development of new models, and for launchings. This year the aeronautics system has several important models that are to fly for the first time, have their designs finalized, and receive certification. The aeronautics systems will launch several satellites, including newly developed Chinese satellites and three foreign satellites. While ensuring the building of key national projects and special projects during the year, diligent efforts will be made in planning the technological transformation of 11 projects in the satellite application system in order to complete construction and bring them on stream as soon as possible.

In discussing plans for continuing to combine military and civilian endeavors, Lin Zongtang said that major efforts are to be devoted to increase the development of aeronautic and astronautic products for civilian use. The aeronautics system will complete the test flying, model finalization, and certification of the T 7-200B, and the T 8-C model transports, and it will strive to develop the

contract production of aviation spare parts. The aeronautics system will use close attention to satellite applications as a basis for vigorous efforts to increase development of the satellite application system, emphasizing the development of small ground communications stations, satellite television receiving stations, and meteorological imagery receiving equipment. At the same time, it will continue to develop satellite payload services, and promote the entry into international markets of satellite applications products. In addition, it will actively mobilize forces in all industries to provide vigorous support to agriculture, giving development of agricultural aviation and the use of satellites in providing services to agriculture first place in aeronautics and astronautics industry's use of science and technology to invigorate agriculture.

Aeronautics and Astronautics Ministry Institute's Research Goals

92FE0401D Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 13 Feb 92 p 1

[Article by Correspondent Yan Yan [2518 3601]: "Ministry of Aeronautics and Astronautics Second Research Institute Selects International Level Projects as Scientific Research Goals. High Technology Takes Lead in Spurring All-Around Development"]

[Text] For many years to come the Ministry of Aeronautics and Astronautics Second Research Institute will devote itself to the development of high technology in building up the academy. It has selected advanced international levels as it scientific research goal, and it will use this goal as a "turnkey" in promoting scientific research, training human talent, spurring development, and advancing the all-around development of all tasks. During 1991, 35 percent of the advance research projects of this institute met advanced international standards, and 65 percent met advanced domestic standards. In addition, they produced an output value of 600 million yuan for profits of 120 million yuan, making 1992 the best year for returns that the institute has had since its founding 35 years ago.

The institute is an entity in which the four major scientific fields of optics, electronics, mechanics, and acoustics are concentrated. It has technology-intensive research institutions for more than 400 research specialties. Five years ago, this institute forecast the direction in which science and technology would develop in 2000. Then it began pre-research, the tackling of key problems, and the raising by itself of some money to organize both research and development and production. Thus, it made breakthrough achievements on its research projects. The institute used the advantages that its computer simulation technology provided to research and develop a computer design system used internationally during the late 1980's, and a computer-integrated supplementary manufacturing system.

In order to ensure the development of high technology, the institute gave a green light to advance research on high technology in the form of technological transformation, the disbursement of research funds, and authentication of results. The institute used one-fifth of its total annual budget on high technology research. During the past 3 years, three national level laboratories have been built or are about to be founded at the institute following state approval. Since advance research work takes a long time, has a high risk factor, and results are slow in coming, the institute adopted a stage-by-stage critique system for advance research results, having researchers report results in stages. As a result, researchers working on advance research work receive a fair deal in the evaluation of results and distribution of awards.

The institute regards the building of a human talent echelon as a guarantee for the development of high technology, and a major resource for technology reserves. It has drawn up human talent training plans based on a 10-year high technology development plan. It uses a combination of training that itself and other institutions provide for the training of a number of masters degree and doctors degree candidate research fellows. The research specialties of these research fellows are in more than 90 percent of the research fields in which the institute is engaged. An overwhelming majority of them select high technology research projects as topics for their research. While learning, they work on key problems, and solutions to key problems become the substance of the comprehensive oral examinations on their theses or dissertations. These research fellows who receive their training by doing actual research have both a theoretical foundation and practical experience. They have become a vital new force in high technology at the institute.

As a unit involved primarily in research and development of high technology products, combining the translation of research results with the development of high technology has enabled the second institute to operate from a strategically advantageous position in the direct research and development of prototypes and products used in civilian life. This has produced both relatively good financial returns and social benefits for the research institute. Computer simulation technology, an advance research accomplishment of the institute, employs precision imaging and data to simulate the flight of live ammunition, thereby cutting down on the number of live ammunition tests. This accomplishment alone has saved the country 7 million yuan in test expenses. Another advance research achievement, "height finder radar technology" has not only enabled greater measuring accuracy when applied to prototypes, but has also saved the country nearly 10 million yuan in equipment expenses. Production of high quality, high added value products is the starting point for the institute's research and development of civilian goods. The balloon-free wind-finding radar incorporating the advanced international technology of the 1980's, which the institute developed for the National Meteorology Bureau, greatly

improved the accuracy and the range of meteorological forecasting. These achievements, which fill domestic voids, were awarded national science and technology awards first class. Performance of the multi-function anesthesia respirator that the second institute researched and developed meets foreign standards for the same kind of product, and sells at a lower price. This device has found favor with the public and with small hospitals. Supply of the product cannot keep up with demand.

Guangdong Province To Invest in Telecommunications Modernization

92P60241A Beijing DIANXIN JISHU [TELECOMMUNICATIONS TECHNOLOGY] in Chinese No 4, Apr 92 p 47

[Untitled news brief by Huang Wenquan [7806 2429 6898]]

[Text] It has been learned from the recently convened Guangdong Province Communications Work Conference that during the Eighth 5-Year Plan the Guangdong Province P&T [authorities] will hasten the pace of telecommunications development. In the 5-year period, 8 billion yuan will be spent on fixed P&T assets; newly added municipal and rural telephone exchange capacity will total 2.2 million lines; newly laid fiber optic cable will total 2,500 km; [new] digital microwave lines will total 3,000 km; newly added long-distance [telephone] lines will total 50,000, the Guangzhou long-distance communications hub will be expanded, and the international telephone output/input office's functions and capacity will be expanded; the Guangzhou international satellite earth station will be renovated; and the Zhujiang River delta mobile telephone network will be extended to the Shantou and Zhanjiang seacoast prefectures.

Shanghai To Promote Communications Industry in Eighth 5-Year Plan

92P60216A Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 30 Mar 92 p 2

[Article by Mao Xifang [0379 6932 5364]: "Shanghai To Focus on Development of Communications Industry in Eighth 5-Year Plan"]

[Text] The Shanghai municipal government has made a clear decision that the communications industry will be the second pillar (or mainstay) industry to be developed during the Eighth 5-Year Plan and in the final decade of the current century. According to the plan, by the end of the Eighth 5-Year Plan the Shanghai communication industry's [annual] output value should reach at least 5 billion yuan.

In 1991, the Shanghai communications industry's output value was 1.4 billion yuan, double that for the previous year. The technological level and quality of the stored-program-controlled (SPC) [telephone] switches, optoelectronic terminals, and VLSI circuits made in the Shanghai area are in the lead domestically, and have created a situation wherein demand exceeds supply.

During the Eighth 5-Year Plan and in the 10-year period beginning now, the Shanghai communications industry will concentrate on the following nine major projects: annual output of S-1240 SPC switches totaling 2.1 million lines, 200,000 kilometers of optical fiber, 3,000 kilometers of fiber optic cable, 8,000-terminal optoelectronic terminal transmission equipment, 900 MHz mobile communications systems, etc. In order to ensure the implementation of this plan, a Shanghai Municipal Communications Industry Development Leading Group with Shanghai Municipal Party Committee Secretary Wu Bangguo [0702 6721 0948] as group leader has been formed.

Measures To Counter World Qualified Personnel War

92FE0114C Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 5, 18 Sep 91 pp 51-53

[Article by Dai Xiongwu [2071 7160 2976]: "The International Personnel Rivalry War and Ideas for China's Countermeasures"]

[Text] To exist and develop in today's world, all nations and regions are striving to develop new- and high-tech industry, so technical progress must depend on creating scientific research personnel. At present, an international personnel rivalry war is now breaking out. Correctly understanding the situation and actively adopting sound strategies are the realities that every nation must face.

I. The "Personnel Deficit" in Developed Nations

Because every major country wants to gain an advantage in the high-tech realm, they all feel that they have a shortage of S&T personnel. It was revealed by economic departments in the United States that national defense industry departments alone will require 10,000-plus additional advanced experts of all types each year. This includes a 49 percent shortage of electronics experts, a 47.8 percent shortage of aviation experts, and an 80 percent shortage of statistics experts. In addition, estimates by the United States Department of Labor indicate that the United States will at a minimum have to add an additional 50 percent in engineers, 76 percent in biologists, and 50 percent in computer experts on its existing foundation. The United States National Science and Technology Foundation has also made detailed projections based on specialization listings: by 1996, the United States will have a shortage of more than 46,000 science and engineering university graduates. By the year 2000, there will be a shortage of 450,000 to 470,000 scientists and engineers in chemistry, biology, physics, and other fields. By 2006, the shortage will reach 670,000 and by 2010, the shortage will reach 700,000. Such a huge discrepancy has aroused concern and unease in people of all circles. Given the present rate of training personnel in the United States, there is no way this requirement can be met.

England is an old capitalist nation and relatively speaking has a full complement of personnel. However, because of imperfect management and large demand, it will also face a situation of severe shortages. According to a recent annual report issued by a civilian manpower research organization, because of the ardent social demand for science and engineering students during the 1990's, all large enterprises will find it difficult to recruit high-level university graduates. Leaving aside the question of the imbalance of the state's supply of and demand for specialized personnel in all disciplines and speaking in terms solely of total demand in all circles for qualified personnel, all academies and institutes cannot meet the numbers required for training. Although all universities in England began gradually increasing the number of university graduates in 1988 to increase them by 12 percent by 1992, there have been continual increases in the numbers used in society, so there will be an estimated 30 percent shortage of qualified personnel by the end of this century.

According to conservative forecasts, the demand for S&T personnel at the engineer level in France over the next 25 years will increase from the present number of 160,000 to 400,000, but France itself can only train 16,000 a year, so the discrepancy will be quite substantial.

Germany is an advanced nation of Western Europe and its economy has developed very quickly. It needs ever-larger numbers of qualified personnel. Analysis of the relevant data indicates that there will be a shortage of 100,000 for computer technology personnel over the next 20 years and the problem could be even greater for other fields.

A recent survey of Japan's MITI indicates that because of the rapid development of high-tech industry in Japan, many enterprises are now facing a qualified personnel crisis and this situation will become increasingly serious during the 21st Century.

At present, a universal feeling among people is that the "personnel deficit" described above will threaten the continued prosperity of the developed nations and may even threaten their national security. If the personnel shortage problem is not solved, they will be unable to become economic, technological, and military giants.

II. The Personnel Rivalry Is Long-Standing

History has proven that no country can be self-sufficient in science and technology. To obtain the most advanced achievements of mankind, besides major efforts at importing advanced technology, a most realistic method is to accumulate qualified personnel.

The developed countries have adopted many countermeasures to deal with the situation of personnel discontinuity. One of the simplest and most direct methods is to dig under the walls of other countries, meaning digging toward the developed nations as well as digging toward the developing nations. They use a variety of names to recruit qualified personnel from foreign countries for their own use.

At present, the United States is borrowing the "heads" of Western Europe, Western Europe is borrowing the "heads" of the United States, and Japan is borrowing the "heads" of the entire world, so each country is competing against the others. The United States began by relying on imports of qualified personnel. Once-celebrated politicians like Kissinger, Brzezinksi, and others were all "imported" and there are even more imported scientists. The "father of relativity" Einstein, the physicist Frank (Beidi), the nuclear physicist Fermi, and the inventor of the V-2 rocket von Braun were all

lured to the United States during the 1930's and 1940's. During the Second World War, the United States basically relied on foreign scientists for successful development of the atomic bomb, radar, rockets, and so on. During that time, more than 2,000 scientists left their native homes to flee Nazi persecution in Germany and the United States took advantage of this and used gold to attract them to work in the United States. These people played important roles in all departments. For example, nine of the 10 scientists who proposed and directed the atomic bomb scientific research plan were foreigners. One-third of the senior engineers who worked on the once sensational "Apollo" lunar program were of Chinese extraction. Statistics indicate that over the 28-year period from 1946 to 1974, the number of top-level skilled personnel imported to the United States exceeded 240,000.

Japan has unique skills in importing skilled personnel. One of them was a plan to establish a world-class superior S&T personnel center and to use it to lure the best scientists and engineers from other countries. Some 5 years ago, MITI stipulated a policy establishing an International Scientific Cooperation Award Fund which stressed that substantial subsidies would be given to those scientists in foreign countries who came to Japan to participate in high-tech scientific research cooperation and that awards would be given to those who made outstanding achievements. The Japanese government has repeatedly asked scientific research organs, enterprises, and institutions of higher education in Japan to invite over 100 accomplished scientists from foreign countries to come to Japan to participate in S&T cooperation and has used this to draw on collective wisdom and absorb all useful ideas. A second method has been to establish several high-tech laboratories near famous universities or high S&T centers in the United States to draw on local materials. Many large electronics companies (Matsushita, Canon, Fuji, Ricoh, etc.) have or are preparing to establish computer laboratories in the United States and are hiring local United States S&T personnel to do basic research on computers for Japan. A third method is attempts to merge with schools in foreign countries like mergers with enterprises in foreign countries. Reports indicate that because Salem College in Virginia [as published] in the United States, which has a history of more than 100 years, was facing a crisis of imminent closure, Japan's powerful Dingxiang (Teikyo ?) University gave the college a grant of more than $20 million to merge with it. Japanese students are expected to enter Salem College in large numbers over the next 10 years.

Western Europe is also using the "heads" of the United States. In 1989, a Western European electronics company unsuccessfully offered a high salary of $2 million to an integrated circuit expert in the "Silicon Valley" of the United States, so it paid the huge sum of $30 million to buy the enterprise where he worked along with this expert. There are now many French enterprises going to the British Isles to recruit S&T personnel. The United States has attracted the largest number of personnel from England. Statistics from the United States National Science Foundation indicate that about 1,000 scientists and engineers from England move to the United States each year in pursuit of higher living standards. One-fourth of the United States-born members of the British Royal Society now work in foreign countries and 250 of them have moved to the United States.

At present, the international war of rivalry for personnel is occurring not only between the developed and underdeveloped nations, but between the developed nations as well. The overall trend in the outflow of personnel is that personnel from the developing nations are flowing toward more developed and developed countries, from the more developed nations toward the developed nations, and from the developed nations toward a small number of developed nations.

According to an article in the magazine "Asia and Africa Today" from the Soviet Union, 400,000 to 500,000 of the highly qualified specialized personnel working in the developed capitalist nations in the early 1980's came from young developing countries. This figure is about equivalent to one-third of all the scientists, engineers, and physicians in the developing nations at that time. People in foreign countries have calculated that the total cost to the state and individuals of training a specialized technical personnel from elementary school through middle school and high school and on through college is $50,000 to $100,000. Using this as a standard, the developing countries lost a total of more than 1.4 million qualified personnel over the 29-year period from 1960 to 1989, which created direct economic losses of as much as $70 to $140 billion. There are no ways to calculate the indirect losses.

In the area of personnel outflow, Asia accounts for more than 50 percent of the qualified personnel lost from developing countries. Losses of qualified personnel have cost India $13 billion and the outflow of computer experts has resulted in many of India's electronic computers becoming exhibits. There originally were severe shortages of qualified personnel in African countries, but in just a few years' time the United States has "dug up and carried off" several 1,000 personnel of various categories from Africa, which has caused the nations of Africa to suffer more than $2 billion in losses. The economic losses to Arab countries arising from the outflow of qualified personnel amounted to $130 billion by the end of 1986.

In the configuration of the outflow of qualified personnel in today's world, there are basically exports and no imports in the developing nations while the more developed countries have both imports and exports, and the developed countries basically have imports and no exports or imports greater than exports. The result of this trend will be that the rich countries become richer and the poor countries become poorer. Over the past 20

years, nearly all United States Presidents have publicly acknowledged that the reason that the United States was able to be a leading country in the world is closely related to the contributions that skilled personnel from other countries have made to the United States.

Qualified personnel are a most valuable resource and have now become a new value concept in the international economy. Countless examples have proven that whoever absorbs the most personnel from outside is the one who receives the greatest profits, while whoever has a serious outflow of qualified personnel is the one who suffers the most painful losses. The modern commodity economy is continuing to develop and is in particular a sweeping arena of the high and new technology industry revolution that reflects and supports comprehensive national strengths. To exist and develop, both large and small countries must constantly try to widely collect skilled personnel. Besides making efforts at training, they will also carry out a protracted international personnel rivalry war.

III. Ideas for China's Countermeasures

China is a big developing country with a huge population and limited resources. To maintain sustained and stable development of our economy, we must protect and foster our advantages of a large number of skilled personnel in this rivalry war. At present, however, China still lags substantially behind the developed nations. According to 1988 statistics, China has a total of 10.03 million specialized technical personnel of all categories, less than 1 percent of our total population. The number of specialized technical personnel we have per 10,000 population is several times less than the world average level and the shortage is even greater for research personnel in the high S&T realm. A shortage of qualified personnel has become a "bottleneck" that is restricting further development of China's national economy. For this reason, we should work on making a key transition in our personnel resource development plans, meaning a shift from quantitative increases to improving quality. Statistics from a survey by relevant departments indicate that China has vast manpower resources but the quality is not high. This obviously is a major impediment that affects improvement of productivity in China under the conditions of constantly updated industrial technology and equipment levels. Especially troubling is the appearance of aging of the specialized personnel we do have with high-tech duties (the average age is 52.6) and a tendency toward outdated knowledge (69.9 percent of the personnel have never been released from work to study). Estimates are that by the end of the 1990's, a "new fault" [duan ceng 2451 1461—geological fault] many appear in our personnel. This makes the development of high intelligence even more important in China. Dealing with realities, taking account of our national conditions, and making long-term considerations, I offer these ideas.

1. Establish a social custom of respecting skilled personnel and respecting knowledge, improve the soft environment for skilled personnel, create excellent conditions for all S&T personnel to "emit light and generate heat", implement the linkage of remuneration with accomplishments for "fast rhythm, good treatment", and achieve "full load, high efficiency" operation.

2. Establish a continuing education registration system, focus on continuing education networks with the construction of training base areas as the primary topic, speed up the renewal of knowledge of specialized technical personnel.

3. Implement special plans in the basic sciences and high-tech fields, establish a scientific research "national team" to ensure that vanguard S&T in China is adapted to advanced international levels, encourage scientists and engineers to establish and lead high-tech industry.

4. Expand the circulation of skilled personnel from foreign countries, create excellent working and living conditions, attract students studying abroad to return to China, and strive to increase the number of post-doctoral work stations over the next 5 years to accommodate larger numbers of post-doctoral researchers.

5. Perfect competition mechanisms, reinforce personnel administration, apply the law of value, regulate personnel operational behavior, perfect evaluation systems, destroy the old custom of ranking according to seniority. Be concerned with extracting and selecting potential personnel, provide stages and opportunities for all categories of qualified personnel to display their skills.

6. Provide good matching policies, determine major policies conducive to accelerating S&T progress, supplement them with rational education policies, gradually form a "China-based S&T" policy system.

7. Establish a legal guarantee system, promote personnel circulation, reform the traditional administrative mechanisms of personnel departments (or units), actively open up personnel markets, make personnel circulation legal, reliable, orderly, and systematic.

Measures To Solve Qualified Personnel Gap

92FE0114B Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 5, 18 Sep 91 pp 48-50

[Article by Chun Bo [2504 0590] and Xue Jun [1331 6511]: "Analysis and Countermeasures for the Personnel Fault Problem"]

[Text]

I. Definition of Personnel Fault

Information about personnel faults [duan ceng 2451 1461—geological fault] has been coming from all posts

in China's specialized technical work recently. Summarizing the situation in all areas, they are manifested mainly as:

1. In the age structure, a middle-aged valley in the age structure distribution of China's specialized technical staffs, meaning that the number of specialized technical personnel between the ages of 35 and 45 accounts for a too-small proportion of the overall specialized technical staff.

There is a certain inevitability behind the continuation of this problem to date. The main reason is the delayed growth of a generation of people throughout the entire 10 years of the Cultural Revolution. Back at the end of the Cultural Revolution, people were already concerned with this problem and the need to adopt several remedial measures to melt down and educate the worker, peasant, and soldier students who had graduated during the Cultural Revolution and use the "five universities" including the Television University, Correspondence University, and so on for on-the-job education, in particular using common higher education to add several middle-aged and young specialized technical personnel to specialized technical staffs and alleviate this problem. At the end of 1989, the average age of specialized technical personnel in China's business units under ownership by the whole people was 37.91 years, so for the specialized technical staff as a whole, the proportions accounted for by each age group were basically rational, and among them there were no apparent "faults" in middle and elementary school education, political and legal work, finance work, cultural and artistic creations, and other areas in the age structure of specialized technical staffs. The more prominent problem at present is in institutions of higher education, scientific research units, and engineering technology, health, agricultural, and other high-level research organs. For example, in 1989 the number of teachers in the 36 to 45 age range among the teaching staffs in China's common institutions of higher education accounted for just 14.5 percent of the total number of teachers. The situation is even more serious in China's agricultural colleges and schools, where teachers in this age group account for just 9.48 percent.

2. In the job title structure, there is serious aging in the ages of personnel with advanced specialized technical duties (job titles). Statistics for the end of 1989 indicate that the average age of personnel in China at present with advanced specialized technical duties (job titles) has reached 53 years. In China's common institutions of higher education, professors and associate professors more than 51 years of age account for 96.4 percent of the total number of professors and 71.8 percent of the associate professors. At the same time, the proportion of personnel under 40 years of age with advanced specialized technical duties is too small. In the "five main systems", which include institutions of higher education and scientific research units, personnel with advanced specialized technical duties under 40 years of age accounted for just 0.12 percent, 0.53 percent, 0.56 percent, 0.2 percent, and 0.7 percent in each of the systems as a whole. Projections indicate that over 80 percent of personnel will reach retirement age within 10 years. At that time, if all of the existing 41 to 50 years of age middle-level specialized technical personnel are promoted to corresponding advanced specialized technical duties, there will still be a 30 percent reduction in personnel with advanced specialized technical duties.

3. Regarding personnel echelon construction, middle-aged and young specialized technical staffs are unstable and there is an extremely serious problem with the outflow of superior quality personnel.

At present, China's middle-aged and young staffs already account for more than one-half of our entire specialized technical staff. Due to the effects of many factors over the past several years, a substantial portion of middle-aged and young specialized technical personnel in this staff feel ill at ease about their jobs and are particularly discontent with contributing and working in China, and their "enthusiasm for going to foreign countries" and "enthusiasm for starting businesses" continue to grow.

According to statistics from five key institutions of higher education, a total of 6,104 teachers were added between 1981 and 1989. By the end of 1989, some 1,950 had already gone to study in foreign countries, equal to 32 percent of the total number of young teachers in these colleges over the same period of time. A survey of 36 units under the jurisdiction of a certain academy of sciences showed that nearly 80 percent of the college graduates who had entered the academy during the 1980's had left China and most of them have not returned yet. A survey of a certain university in Shanghai showed that more than 95 percent of the middle-aged and young teachers had expressed an interest in going to foreign countries. The outflow of personnel in a certain college over the past several years has increased at a rate of 106 percent each year.

The outflow of large numbers of middle-aged and young specialized technical personnel from their work posts has further exacerbated the problem of "faults" in the age structure of specialized technical staffs, and at the same time a new "fault" has taken shape in young staffs below 36 years of age. This problem can be found in all of the specialized technical posts and at all personnel levels in China and it is a trend that deserves special attention at the present time.

II. An Estimate of the Problem of Personnel "Faults"

The effects of personnel "faults" on China's specialized technical work are becoming increasingly apparent and are expressed mainly in these areas at present:

1. The existence of the "faults" has placed too many heavy specialized technical work burdens on the shoulders of middle-aged and elderly specialized technical personnel over 36 years of age. The heavy work has added to their burdens and affected renewal of their

knowledge and further improvement of their professional levels. Statistics for 1990 indicate that with the exception of one person under 45 years of age, all of the 128 discipline leaders at the Shenyang Branch of the Chinese Academy of Sciences [CAS] were above 50 years of age. Of the 15 directors and deputy directors of research offices, those 46 to 59 years of age accounted for 95 percent and 83.3 percent, respectively. For topical group leaders and deputy group leaders, those 46 to 59 years of age accounted for 83.3 percent and 86.3 percent, respectively. The average age of topic directors at the province level and above in Zhejiang Agricultural University in 1990 was 54.54 years, including 77.42 percent above 51 years of age and just 6.45 percent under 35 years of age.

2. As large numbers of advanced specialized technical personnel continue to retire, "faults" and factors in other areas mean that discipline leaders and key professional personnel in many disciplines and specializations and at certain levels already face the threat of having no personnel to continue. Some disciplines that hold a vanguard status in China will lose their advantages as a result. For example, a certain university in Henan has lost the right to recruit graduate students in two disciplines and several projects to attack major S&T problems led by this university now find it hard to select "command" personnel. A Ph.D. discipline point at a certain university in Zhejiang has considerable influence on similar colleges and universities throughout China. The only teacher of Ph.D. students in this discipline point is now 73 years old and no suitable person has been selected so far to assume his teaching duties. Because middle-aged and young specialized technical personnel must become academic leaders and key professional personnel standards in ideology and working styles, professional quality, practical ability, academic status, and other areas, a certain process is required. Problems in this area will become more acute for some time into the future and should receive a high degree of attention.

III. Countermeasures and Measures for Alleviating the Personnel Fault Problem

1. Reinforce comprehensive management of specialized technical staffs. Reform over the past 10-plus years has shown that specialized technical staff construction work must implement comprehensive management from the heights of social systems engineering. It is hard to be effective by merely formulating policies and adopting measures in certain areas and certain links. Thus, all of society should be concerned with this work item, mutually coordinate, and focus on joint management. Specialized technical personnel administration departments should actively create the conditions in the areas of personnel selection and utilization, continuing education, evaluation of job titles, examinations and awards, and improving the working and living treatment of specialized technical personnel. Education departments should readjust the structure of higher education according to the needs of our national economic and social development. Economic and S&T departments should deal correctly with the relationship between scientific research and production and personnel training and achieve results as well as produced skilled personnel.

2. Focus more on personnel planning work

On the basis of survey research, and based on the real situation in specialized technical staffs and S&T development trends, formulating specialized technical personnel plans is the foundation for more scientific and systematic specialized technical personnel construction work. Practice has shown that plans provide staff construction work with objectives and direction. Moreover, personnel plans based on an S&T development foundation better integrate scientific research work organically with personnel training, with each promoting the other in coordinated development.

Recently, the party and state proposed a 10-year program and Eighth 5-Year Plan for the development of China's economy and society. They suggest that specialized technical personnel administration departments should base themselves on actual conditions in their own departments to focus on formulating the corresponding personnel plans, and in particular should focus on formulating special superior quality middle-aged and young personnel selection and management support plans to create a high-level personnel staff that is adapted to China's economic and social development and that can participate in international S&T competition.

3. Make major efforts to optimize the specialized technical staff structure

At the end of 1990, there were 23.15 million specialized technical personnel of all categories in units under ownership by the whole people in China who have formed a specialized technical staff with a substantial preliminary scale and relatively complete categories. From the perspective of the total number of personnel and speed of training at present, numbers are not the main problem facing China's specialized technical staff construction now. Greater efforts should be made in improving quality and optimizing the structure for a period into the future.

a. Use readjustment of the specialized technical staff distribution among regions, industries, levels, and departments to focus on solving problems like surplus personnel, idle personnel, and so on to alleviate regional and industry personnel shortage problems.

b. Use reinforcement of macro control by the state for actively organizing all categories of specialized technical personnel to support the development of key state industries and departments and key state items and projects to ensure the personnel needs of key industries and departments for development of the national economy over the next 10 years and during the Eighth 5-Year Plan.

c. Use the adoption of various types of continuing education for universal improvement of the political and professional quality of specialized technical personnel.

In particular, we should further improve the ability of superior quality middle-aged and young personnel to participate in international S&T competition and open up new future realms of S&T.

4. Focus on the most important aspects of specialized technical staff construction

Besides the need to focus on improving the overall structure and quality of specialized technical staffs, in the long-term view young discipline leaders and key professionals capable of playing role in organization and opening up are even more important for the continuation and development of China's S&T activities. Accelerate selection and training of key superior quality middle- aged and young specialized technical personnel and discipline leaders. This is the most important of the important tasks for future specialized technical personnel staff construction in China. We propose the adoption of measures in the following areas:

a. Do good intensive and detailed ideological and political work. We must strengthen education in patriotism and socialism for middle-aged and young specialized technical personnel, guide them in establishing a correct world view and outlook on life, strengthen their devotion to work and sense of responsibility, and train in them a rigorous and realistic scientific working style and a spirit of arduous struggle and selfless offering of tribute.

b. Allow key middle-aged and young specialized technical personnel to take on heavy burdens, enable them to improve their skills and mature quickly in work and practice.

c. Create the necessary conditions for further improvement of the scholarly status and social recognition of middle-aged and young specialized technical personnel. For example, actively select and absorb superior quality middle- aged and young specialized technical personnel to enter scholarly groups and scholarly committees at all levels, and commend and reward middle-aged and young experts who have made prominent contributions.

d. Destroy the old practice of ranking according to seniority, promote superior quality middle-aged and young specialized technical personnel with superior skills and who have made prominent contributions based on their actual levels without restriction by study history and seniority, and in accordance with the appointment conditions stipulated by the state. We should support key middle-aged and young specialized technical personnel in independently undertaking scientific research work and provide them with the necessary funding support.

e. Try to solve the real difficulties in work and life of middle-aged and young specialized technical personnel, create the necessary working and living conditions for them, and provide preferential consideration for middle-aged and young specialized technical personnel who have made prominent contributions.

f. Fully foster the role of elderly specialized technical personnel in passing on experience.

5. Reinforce system construction, further perfect an excellent social environment that will allow superior quality personnel to display their skills.

a. Intensify reform of the cadre personnel system, gradually establish a complete and comprehensive management system that is adapted to the characteristics of specialized technical personnel and conforms to our national conditions.

b. Consolidate and develop successful experiences achieved in the area of specialized technical staff construction since the 3d Plenum of the 11th CPC Central Committee, further perfect all types of related matching measures.

c. Adopt positive and effective measures to solve several acute problems as quickly as possible in specialized technical staff construction work like adopting special support plans for middle-aged and young specialized personnel to alleviate personnel faults.

d. Reinforce legislative work, achieve more scientific and legalized specialized technical staff management and personnel training work.

Further Study on Qualified Personnel Management System Reform

92FE0215B Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] in Chinese No 6, Nov 91 pp 29-34

[Article by Hou Yimin [0186 6654 3046] of the Chinese Academy of Sciences [CAS] Science and Technology Policy and Management Science Institute: "A Continued Probe Into Reform of the Qualified Personnel Management System"]

[Text] Abstract:This article concerns the entry of competitive mechanisms into personnel management, focuses on the training of superior quality young personnel, and explores routes for intensive reform of the qualified personnel management system in areas like guidance of organizations and personnel by categories and levels, engaging in rational combinations, eliminating internal consumption and personnel circulation with preparedness and sincerity, improving the quality of cadres and staffs, using management colleges for strict training, and so on.

Qualified personnel are the primary factor among the factors of the forces of production for the economy and technology. Because of policy inputs and management factors, China's S&T staffs are unstable and considerable difficulty will be involved in more intensive reform of the S&T system. Examples include personnel faults [duan ceng 2451 1461—geological fault], aging of personnel, and temporary shortages that exist in S&T staffs.

Departmental ownership systems and imperfect employment mechanisms and social guarantee systems create difficulties for qualified S&T personnel circulation. Selfish departmentalism, jealousy of abilities and envy of capabilities, appointment of people by favoritism, inaction and internal consumption, and other unreasonable factors limit the fostering of the potential of qualified personnel. S&T personnel have obviously poor competitiveness because of internal qualities, the external environment, and other factors. The relatively poor treatment and hardships in life of S&T personnel and relatively acute phenomena of "brain inversion" in allocation are extremely unfavorable for the stability of China's S&T staffs and the blind "enthusiasm for leaving China" has further shocked S&T staffs. Imperfect job title and appointment systems have affected the growth of qualified personnel and the fostering of their initiative, and so on.

It is precisely for these reasons that we urgently need excellent personnel management and countermeasures to overcome these negative factors. We must bring competitive mechanisms into our management system and work to eliminate the old system that was characterized by inbreeding or manufacturing internal consumption, "eating from the big common pot", and low efficiency.

I. Strict Appointment Measures Are Practical

There should still be differential treatment for elderly, middle-aged, and young S&T personnel in R&D organizations.

For historical reasons, although competitive mechanisms should also be brought in among older comrades to continue fostering their cautious and conscientious work initiative, they also should be permitted to make a transition in policy continuity because the abnormal political environment over 10 or 20 years caused them to miss the opportunity to serve their country, while there are still things that they can do and their loyalty to the nation and the people, their bravery in scaling the peaks, conscientiously going on the spot, willingness to bear the burdens of their office in work, and their thoroughness and honesty in life are models for our successors, and if they are able, we should continue to provide them with work opportunities and improve their living conditions.

Correct policies and excellent management for middle-aged and young comrades concern the basic interests of China's present and future prospects. The role of middle-aged comrades today is self-evident, but there should be new methods for newly entering young people. Overall, they first of all should have substantial study histories and degrees, strict appointment testing, implement bidirectional selection, and promote early circulation. Young people are natural successors without relying solely on their age advantages.

Past lessons show that we must prevent two tendencies. At present, we cannot label some young people unreliable and untrustworthy because they have buried themselves in studying foreign languages and want to go abroad. Neither can we ignore the initiative of the arduous efforts of middle-aged and elderly comrades or their contributions because we want to promote newly emerging forces so that they are competing in a new unequal status, which would damage their enthusiasm to work for society. Moreover, China's establishment of a degree system and the creation of doctoral diplomas was something that happened after bringing order out of chaos in the 1980's. If young people are simply awarded the glory of successors without effort, this will have negative effects on their healthy growth.

These two tendencies could damage the present and future of our cause. Thus, we should arrange as quickly as possible for newly entering young people to participate in scientific research practice and there should be a specific proportion of young people who participate in important high-tech projects. Select key young people to assume leadership work in research offices and topic groups, participate in scholarly assessment and consulting work in academies and institutes, and participate in scholarly activities in China and foreign countries to allow them to display and increase their skills in practice.

There must be clear stipulations of the degree requirements and age requirements for promotions to specialized technical posts. In the present stage, there should be special plans for young S&T personnel in promotions to high-level specialized technical posts and they should comprise a specific proportion. Conduct on the job training for young people in a planned way and provide focused training for superior quality personnel. There should be public testing of employed graduate students who sign up for tests, who apply for on the job degrees, and who go to foreign countries for advanced training, and so on.

At the same time, we cannot neglect the status of those who have studied and developed their skills on their own and made definite contributions.

When bringing in competitive mechanisms, we must renew our understanding of the role of bonuses. Bonuses have lost their original intent in many organizations now and become new added wages, and a portion of internal bonus allocations have become "a big common pot". This situation must be changed. With a prerequisite of clearly stipulating that every person in each organization must complete their objectives and tasks, besides base awards or average awards, the ranking of bonus allocations must be separated for that part of work where quantitative evaluations or fair evaluations can be made so they play a stimulation role in rewarding diligence and punishing laziness. This would create a situation in which everyone vies in their work. Otherwise, we will see work being passed back and forth and fewer and fewer people will do good things.

Now, we must find the corresponding countermeasures to alleviate the personnel faults that are so troubling to S&T circles.

First, the training of qualified young people must be planned and we cannot be inflexible but must make choices according to real circumstances. We must include qualified personnel work in the long-term development programs of all research organizations and systematize and normalize personnel work from utilization and evaluation of work accomplishments, inspection of ethics and character, to promotions and awards.

Second, measures like establishing young people's S&T research offices and young people's science associations and establishing young people's science funds, young people's S&T awards, and so on can be adopted to train and select talented young people to help provide successors for China's S&T activities.

Third, with a prerequisite of equal treatment without discrimination for Ph.D.'s earned in China and Ph.D.'s earned through study in foreign countries, we should adopt practical measures to bring talented personnel studying in foreign countries who have made achievements, have high levels and great influence, and who can play their role in job posts to return to China. In addition, we can also implement Chinese-foreign bidirectional integrated training, directional training, and other auxiliary methods to use multiple channels for collecting talented personnel. Besides needing to increase the required investments to improve the treatment of intellectuals, the state should also formulate stable and seldom-changing laws and regulations for going to study in foreign countries and establish liaison stations in developed nations to recruit talented personnel.

In addition, we should engage in international coordination with countries that solicit or rope in talented personnel and use international agreements to restrict their enormous attraction to skilled personnel from developing nations or at least we must make them create opportunities for qualified personnel from other countries to serve their motherlands or implement certain types of international qualified personnel exchanges for mutual benefit.

II. Reform the Job Title and Appointment System

We should implement reforms of our original job title or appointment system and carry out a series of divided flows, separate evaluations from appointments, divide job grades by grades and levels, and classify units. Series of divided flows refer to making several readjustments in series, implementing guidance by categories, and taking individual characteristics and historical circumstances into consideration to formulate different evaluation regulations for each series according to their own characteristics and apply different measurement and assessment methods, formulate different standards, and adopt different evaluation and management methods.

Separation of evaluation and appointment means implementing a technical post appointment system and job title evaluation system certain levels or certain periods in certain series to implement a separation of post appointments and evaluations. There could even be public evaluation and appointment for society as a whole (this is being tried out in the CAS Theoretical Physics Institute) and we can also appoint qualified high-tech personnel from foreign countries.

For wage and job title grades and levels, researchers and professors can be divided into grades 1, 2, and 3, assistant researchers and associate professors can be divided into grades 4, 5, and 6. Advanced workers would have grades 1 to 6, engineers would have grades 7, 8, and 9, assistant workers would have grades 10, 11, and 12, technical personnel would have grades 13 and 14, and so on. Middle and elementary school teachers can also be divided into grades and levels.

Inspections of qualified high-tech R&D personnel cannot be merely superficial, especially for development-type personnel. Consideration should also be given to their social activities and capabilities, organizational and management capabilities, ethics and character, cooperative abilities, information gathering capabilities, creativity, stamina, eloquence, writings, renewed study, and other capabilities.

Acceptance and completion of high-tech R&D projects should be used as one indicator for classification and division into grades and levels for organizations and S&T personnel.

When considering reform of the organization and personnel management systems, we must first make a correct distinction of the qualities of organizations and each internal part: Are they basic research or applied research? Are they technology development or experimental development? Or are they technical service or technology extension? Only by clearly differentiating qualities or categories can we accurately provide guidance by categories. Otherwise, one standard will be used to deal with three objectives and the outcome will not be favorable for China's S&T progress nor will it help promote economic development. How can a single type of skilled personnel management system be used to evaluate two research organizations with entirely different qualities like the CAS Theoretical Physics Institute and the Beijing Chemical Fiber Institute?

III. Have Prepared Rational Combinations

A 1991 national survey research work report by the State Science and Technology Commission S&T System and Management Research Institute pointed out that very few management personnel or scientific research personnel assessed the implementation results as good of reforming the management system in trial implementation of optimized combinations over the past several years. Instead, most felt that the results were poor. Nevertheless, most people felt that we should continue to persist with and perfect optimized combinations.

Comprehensive implementation of optimized combinations has slowed down during the past 2 years. We feel that the problem is not that this reformed system is in itself bad. There were many causes for the problems that appeared in the early stages. For example, there were insufficient ideological and organizational preparations prior to trial implementation, the quality of certain basic-level cadres was too poor, there were too many selfish ideas and personal considerations, methods were rigid and simplistic, and there even appeared phenomena of vicious slander, frame-ups, and fabrications, social guarantee systems were far from formed, and so on. These caused side-effects and even resulted in certain units undermining the reputation of "optimized combinations". Some people viewed "optimized combinations" as an opportunity to establish independent kingdoms. Although some carried out "optimization", people left out of the "combinations" could still only be "digested" by their own units in the end because no avenues could be found for them and they could not be pushed out into society.

Reform should encourage competition, mobilize the initiative of personnel, and improve efficiency. We cannot allow it to be cheapened by those people who are good at scheming to work on internal consumption, unwilling to take risks, avoid competition, and always seek advantages. Even less can we allow certain cadres to use familiar policy loopholes, float between two improper interests, try to avoid doing arduous and honest labor or even play politics, and hope only to gain benefits.

In "optimized combinations", if several people use improper means to exclude other people, it will be difficult for this type of "combination" to gain respect in society and society will find it difficult to avoid hidden crises or may even brew up contradictions of opposition. A fixed social psychology momentum with a 40-year history that has already formed a sense of job security cannot acknowledge the interpersonal realities of bourgeois internal strife and cheating. News coming from all areas over the past several years shows that we must prevent the occurrence of bloody incidents.

Achieving a rationalized or optimized labor combination for scientific research and production should be a continual and gradual process. Simply viewing it as cutting out a few people or launching battles like in political movements would be very inappropriate.

A rational combination or optimized combination of labor should refer to rational production relationships and labor force structures and to optimization of the qualities and scale of a labor force. Actually, they require the achievement of organic integration of scientific research and production materials within units.

For many years, the phenomenon of irrational labor combinations has been widespread in China. Examples include overstaffed organizations, having more hands than are needed, poor results, low efficiency, insufficient internal motive power in the labor force, and so on. The fundamental reason is that for a long time China has not selected labor employment mechanisms according to the laws of a socialist commodity economy. We have consistently had a centralized job placement system that has violated the laws of proportional allocation, equilibrium of supply and demand, and selection of the best through competition. Despite 10 years of reform, the commodity economy and market development are far from mature, the causes of the formation of non-optimum labor combinations are far from being eliminated, and mechanisms are the same as before, and it will be hard to avoid poor results if we try in one day or take the opportunity to replace old charms with new ones of younger ages and rashly announce that we have achieved optimized combinations in several units.

To achieve rational labor combinations, we must first of all optimize mechanisms, meaning that enterprises and institutions have their own decision-making, administrative, personnel selection, and allocation mechanisms, that they have independent guarantees of their interests, that they enjoy successful honor and delight, and that they can bear the responsibility and agony of failure. They cannot strive for happiness when they profit and allow the state to bear the burden when they have losses. This is a type of risk mechanism. In it, there should be competition for employment, a perfect training system, clear job responsibilities, and systematic examination standards and labor remuneration. This is a stimulus mechanism. They should also have excellent qualified personnel circulation centers and a social guarantee system and there should be a suitable proportion of those waiting for positions, labor disputes and arbitration for unjust reductions, bilateral guarantees, laws, and regulations for the rights of both managers and administrators and laborers, and other mechanisms.

For R&D organizations, it should be pointed out at the present time that the rules for rational combinations of personnel and skilled personnel circulation must be straightened out.

First, we should establish a post responsibility system for organizations and their members, implement scientific assignments and quotas, do statistical analysis, and adhere to the principles of open competition and equal competition so that there are regulations that can be followed as well as openness. We should strengthen examinations and inspections. Only on this basis can selections be made for appointments. We cannot adopt coercive methods when the conditions are not mature or there are no ways out. We must think of ways to eliminate unreasonable "fighting in the nest", "retaliation", "appointment by favoritism", "forming bands and cliques", and other phenomena. Otherwise, rumormongering and slander, violent incidents, and other socially repulsive phenomena may be created, or they may move toward the backside of things and become "inferior-grade combinations". An inspection of the results of units that were trial points for optimized combinations was made in early 1988 using various

methods. Successful experiences should be fostered and mistakes should not be hidden. Lessons should be summarized from units that performed poorly or locations where serious outcomes were created.

If a research organization is constantly scrambling for power and profit for many years after it is established, when there are "many officers and few troops", or when qualified personnel find it hard to exist when they get there and have no leaders in their discipline, and when they cannot produce their share of research achievements or work that affects the development of the country or local areas, ore when they are merely "S&T peddlers", then consideration should be given to whether or not such research organizations have the value and necessity of existence.

Because the independent administrative decision-making rights of R&D organizations and the consciousness of S&T personnel in pursuing their interests have been strengthened, contradictions between the rights and duties of each of the two parties may move from being concealed to being open and administrators have the responsibility of not intensifying this contradiction. The relationships within the people, in a collective, and between people should be measured in terms of harmony. We absolutely cannot allow the unique phenomena of people fighting people and people punishing people in China during the 1960's and 1970's to continue or even be carried over into the 21st Century. When an organization permits mediocre people or vile people to rule by force, it is hard to have hope for the activities of this organization and there is even less chance that it will produce Nobel Prize winning scientists.

[Herbert A.] Simon feels that in certain situations, the principle of maximum value should be replaced with the "standard of satisfaction". There is a certain truth to this view.

A method must be found to overcome "internal consumption", which has been held in such broad contempt by scholars in China and foreign countries. Quantitative and accomplishment assessment should be implemented for S&T personnel and they should by systematized to replace personal control with legal control. There must be strict discipline and strict enforcement of the law. We certainly cannot allow the abominable behavior of power exceeding the law to flourish. Prevent inappropriate measures of jealousy and envy in personnel utilization like vicious reports that contain rumormongering and slanderous fabrications and malicious vilification. Such illegal, undisciplined, and degenerate methods smother talented personnel. We must create an environment that allows people to display and make the best possible use of their talents so that those people who are good at using the methods inherited from the "Great Cultural Revolution" to maneuver into jobs are exposed to the light of public opinion when necessary and that those who cause serious outcomes are dealt with by discipline inspection departments or even legal organizations to make it hard for internal consumption to succeed. Otherwise, "optimized combinations" will instead "discard" capable and virtuous people who dedicated to their work but not adept at making use of connections and "reformers with lofty ambitions will have no alternative but incompetent people".

Prior to the completion of social guarantee and socialized service systems, prior to the completion of reform of the residential registration system, and prior to the implementation of contractual relationships between individuals and units for all the personnel in units, which is to say at the present time, it is more practical and feasible for scientific research personnel to achieve circulation internally and have exchanges of knowledge and technology with the outside. On the basis of their institutional arrangements and the requirements of scientific research topics, they can break through the boundaries of research offices and groups and engage in voluntary combinations, and of course they can also be transferred according to their wishes out of their former departments. This sort of circulation would help S&T personnel find positions that are truly suitable for themselves in circulation. The methods of inviting visiting research personnel for second jobs or short-term work on cooperative projects can enliven the research atmosphere on one hand and would be more economical in terms of expenditures on the other hand. In this process, interference from intermediate levels should be reduced and personnel departments should only play a role in building bridges and making administrative arrangements and should not make judgements.

Attention should be given to these points in personnel circulation:

Personnel readjustments should be made on the basis of objectives so that the structure of S&T staffs on the front line gradually become rational. We should gradually straighten out the establishment of organizations to adapt to the shifts and changes in research institutes. We must adopt multiple routes using economic measures, social regulation measures, and administrative measures to make arrangements for personnel awaiting the readjustments and motivate the initiative of all personnel so that there is some leeway for reversal of personnel circulation. For example, knowledge exchanges can be used without changing registration, residences, establishments, and so on, as can cooperation on projects with the outside and other arrangements to undertake work. We can also adapt to local conditions and make arrangements for surplus personnel in random contingencies by establishing development-type or service-type companies.

There is a type of "circulating research system" in Japan centered on people.

Because Japan like China implemented a closed personnel management system, their lifetime hiring system greatly restricted personnel circulation. For this reason, they have implemented a "circulating research system"

on a trial basis to compensate and are using it to promote exploratory research to explore new technologies. The government pays all activity fees. Existing facilities in research organizations, universities, or enterprises are used mainly to absorb research personnel from enterprises. Superior quality young research personnel scattered through civilian, college, and official organizations are brought together and organized to conduct exploratory research. Hiring contracts with specific time limits are signed with them, with a 5-year time limit on research. When their time is up, their research organization is dissolved regardless of its achievements in research work and the personnel involved return to their original units. This organization is open domestically and to foreign countries. The goal in this sort of "expediting system" is provide a scholarly environment to research personnel with abundant creative skills to foster their creativity.

No conclusion has been drawn as to whether or not this system can compensate for the negative aspects of the lifetime hiring system. For high-tech, China can copy it for an experiment to see whether or not a soft scientific research center arrangement is feasible. The time period does not have to be set at 5 years, however.

Arrangements for qualified personnel require policies formulated on the basis of actual circumstances. We cannot adopt a fixed or stereotyped model. For example, the Sichuan Space Industry System adopted an "out of the mountains policy" that placed high-level skilled technical personnel in central cities or coastal special economic zones to establish civilian product development centers and "technology windows" that displayed the powerful momentum of the space industry in competing in civilian product markets and enabled S&T personnel to use their skills. They established new living base areas in central cities and solved the problems of dealing with old age and the educational problems of sons and daughters for S&T personnel who had struggled for a long time in deep mountain gorges. With a prerequisite of ensuring military products, they can also develop civilian products.

IV. Improve the Quality of Cadre Staffs

For the past 40-plus years, in regard to administrative personnel entering S&T leadership organs at all levels in China, prior to the "Great Cultural Revolution" we relied mainly on cadres who had been tested in battle, during the "Cultural Revolution" we relied on soldiers and workers, and after the "Cultural Revolution" we relied mainly on cadres selected from among S&T personnel. With the exception of the abnormal period during the "Cultural Revolution", most of them received training for varying periods in party schools or cadre schools at different levels. Under the historical circumstances of the past, measures that did not fail were accepted as being wise ones. However, the experiences and lessons over more than 40 years show that all of them have definite superficial qualities and limitations and we can no longer use military concepts, guerrilla actions, mechanical operations, or bookishness to direct and manage modern economic and technological work.

After a period of years, for the leadership groups that will enter high-tech R&D organizations, besides having to have real leadership, organizational, and managerial experience and an essential foundation of scientific and technical knowledge, they will usually also have to have received standard education in state-level or local-level economic and technological management colleges and obtained formal graduation degrees or certificates of equivalency for this type of educational background before they will be able to participate in leadership and management. Otherwise, they cannot be given posts. The conditions are now being prepared to propose this type of requirement because all departments have already or are now involved in establishing various types of management colleges in China for the past several years and the results of the experiments have been excellent.

If we adhere to the principle of seeking truth from facts and follow in order and advance step by step, reform of the personnel management system can develop toward greater depths.

[references omitted]

State To Subsidize More Intellectuals

40101015C Beijing CHINA DAILY (National) in English 18 Apr 92 p 3

[Text] The Chinese Government will give more experts, scholars and technicians special government subsidies this year, as a sign of respect for Chinese intellectuals.

The Ministry of Personnel is now busy arranging government departments at various levels for selecting the right candidates, according to a report in yesterday's PEOPLE'S DAILY.

The report said that granting special subsidies to Chinese experts and scholars who have made outstanding contributions to the country's modernization drive is an important policy of the State Council and the Central Committee of the Chinese Communist Party.

The policy reflects retired leader Deng Xiaoping's thoughts that science and technology are primary productive forces.

The report noted that it also shows the government's resolve to improve the living standards of China's intellectuals.

Most Chinese intellectuals live in penury, a discouraging tradition in Chinese history.

According to the Ministry of Personnel, most of the candidates for the 1992 special subsidies will be young and middle-aged experts, scholars and technicians who work at the forefront of science and technology.

The State Council started a similar practice of awarding individuals 100 yuan ($18.5) per month as special subsidies in 1990.

At present, more than 11,000 experts, scholars and technicians are enjoying such State Council subsidies, the report added.

The government's call for bolder reforms and wider opening-up to the world need the growing involvement of Chinese intellectuals. (CD News)

New Lures for Overseas Talent

40101015B Beijing CHINA DAILY (National) in English 31 Mar 92 p 3

[Text] Guiyang (XINHUA)—The Chinese Academy of Sciences (CAS) has drafted a package of preferential policies designed to attract home more Chinese intellectuals presently studying abroad.

The policies were revealed at a symposium on study abroad held here. The policies guarantee that additional government and public programmes to send young and middle-aged scientists abroad for study, and that those who have returned to China are free to go out again.

In addition, the academy has decided to improve the working and living conditions of outstanding scientists currently studying abroad by granting them additional rewards and other financial aid.

"The new preferential policies are in accordance with China's policy of further opening to the outside world, and are designed to create a broad and more attractive environment," said Shi Tingjun, deputy director of the CAS Education Bureau.

Beginning this year, the CAS will establish a special annual fund of $500,000 to be used to encourage outstanding scientists to return to China. Intellectuals who receive grants from the fund will be allowed to purchase specified scientific instruments and other materials for use in scientific research prior to their return.

The policies also guarantee greater freedom to travel abroad after they have returned, and while basing their research in China they will be allowed to visit foreign countries on a regular basis. Scientists who choose to conduct their research abroad will be allowed intermittent visits to China.

In addition, the new policy urges intellectuals studying abroad to continue to serve China by returning to give lectures, conduct symposiums, provide research materials or information, or participate in internal research programmes.

Statistics show that the CAS invested more than $40 million during the 14 years up to the end of 1991 to send more than 7,500 staff personnel, 5,500 visiting scholars and 2,000 postgraduates to 41 countries and regions.

So far, the 3,700-plus of the group who have returned to China work in the mainstream of China's science and technology industry.

Mobility of Qualified Personnel Studied

92FE0276C Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 20 Dec 91 p 4

[Article by Hao Tieying [6787 6993 5391] and Liu Baoan [0491 1405 1344]: "Forecasting Qualified Personnel Mobility Trends and Measures That Should Be Adopted"]

[Text] To meet the needs of reform and opening up and developing a socialist commodity economy, China has brought in market competition mechanisms into the management of skilled personnel, which has accelerated the speed of personnel circulation. Since 1986, personnel mobility organizations at all levels in China have registered a total of 1.146 million people, including 740,000 people who successfully managed mobility. About one-third moved into township and town enterprises, foreign business investment enterprises, and civilian-run individual enterprises. More than 20 provinces and municipalities have used personnel mobility organizations to bring in over 160,000 qualified personnel of various categories and the qualified personnel mobility organizations in 15 provinces and municipalities have assisted township and town enterprises with 350,000 specialized technical personnel. At the same time, all provinces and municipalities have been actively organizing large groups of specialized technical personnel to use the form of knowledge circulation to support medium-sized and small enterprises, township and town enterprises, and the front line of agricultural production. The achievements in qualified personnel circulation work have been noteworthy and they are playing an active role in serving economic construction.

According to the requirements in the National Economic and Social Development 10-Year Program and Eighth 5-Year Plan formulated by the CPC Central Committee, to meet the requirements for readjustment and further development of China's economy, the overall principle of qualified personnel circulation work should be: under the guidance of state macro plans, make planned allocation the main factor (including directive plan and guidance plan allocation) and market regulation an auxiliary factor. On a foundation of meeting the qualified personnel requirements of the relevant regions, departments, units, and key state construction projects, perfect social regulation mechanisms for personnel mobility, gradually form rational qualified personnel deployments, and strive to let everyone foster and use their skills to ensure the smooth achievement of China's second strategic objective in modernization and construction. Forecasts indicate that the overall trends in qualified personnel mobility in the short term in China are:

1) Overall, a reduction in socially regulated skilled personnel circulation, manifested primarily in a continued expansion of the supply market and a relative shrinkage in the demand market, and a significant reduction in the success rate of socially regulated circulation. 2) State use of administrative directive methods to assign all categories of qualified personnel to the relevant regions, departments, and units will account for a greater proportion of the total number of personnel circulating. 3) The primary direction of qualified personnel mobility will be toward agriculture, energy resources, communication, communications, the raw materials industry, and other key industries, key state projects, and key enterprises, and will be carried out in a planned and rhythmic manner under state guidance. 4) Economically developed regions and coastal economic development zones will continue to enjoy a huge advantage in attracting skilled personnel, but some qualified personnel will begin using various forms to flow toward nationality regions, frontier regions, and economically underdeveloped regions. 5) Chinese-foreign joint investment enterprises, Chinese-foreign cooperative management enterprises, and independent investment foreign business enterprises will continue to be the hot points of personnel mobility in most regions. 6) Personnel mobility patterns will become more diversified. Besides reassignments, forms like recruiting, borrowing, intellectual support, and so on will become more lively and part-time second jobs will develop toward organization. 7) There will be a substantial increase in the proportion of senior and mid-level specialized technical personnel in qualified personnel circulation and middle-aged personnel with relatively abundant practical experience will be favored. 8) Development and training of local qualified personnel, reinforced intellectual mobility, and economic and technical cooperation will attract widespread attention.

With these new development trends in qualified personnel mobility, we must readjust the focus of our work and adopt the corresponding measures.

1) Gradually explore and establish a social mobility mechanism that conforms to the requirements for developing China's socialist commodity economy under macro guidance by the state with plans as the main factor and the market as an auxiliary factor. 2) Formulate and perfect various types of preferential policies adapted to economic development that also help stabilize existing qualified personnel and control the out-flow of skilled personnel. 3) Reinforce political and ideological work, guide the circulation of all categories of qualified personnel toward locations where the state needs them the most. 4) Have prominent foci, focus on gathering qualified personnel for agriculture, energy resources, communication, communications, raw materials, and other key industries, key state and provincial projects, and key enterprises. 5) Conscientiously do good qualified personnel mobility work in state-run large and medium-sized enterprises, scientific research academies and institutes, and institutions of higher education, encourage excess personnel to flow toward areas with shortages of qualified personnel. 6) Focus on local resource and industrial advantages, actively do good development and training of local qualified personnel, pay special attention to changing the situation of qualified personnel shortages and poor personnel quality in nationality regions, frontier regions, and economically underdeveloped regions. 7) Daily work in qualified personnel mobility should be focused on internal exchanges, technical consulting, part-time job services, intellectual support, and so on without changing the administrative jurisdictional relationships of qualified personnel. 8) Be concerned with readjustment of the structure of specialized technical personnel in all regions and departments, make qualified personnel deployments more rational. 9) Establish social guarantee systems for qualified personnel, do good personnel archives management for circulating personnel, actively create the conditions for solving the unemployment insurance and other socialized service problems of qualified personnel, continually open up fields of professional service for qualified personnel circulation. 10) Establish qualified personnel information management systems, perfect economic and technical information networks for qualified personnel, immediately understand, grasp, and transmit qualified personnel supply and demand information, and serve qualified personnel mobility work.

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